GR

ORIGINAL SUBMISSION

# HOGAN & HARTSON
L.L.P.

GRN #000005

MARTIN J. HAHN
PARTNER
DIRECT DIAL (202) 637-5926
INTERNET MJH@DC2.HHLAW.COM

April 23, 1998

COLUMBIA SQUARE
555 THIRTEENTH STREET, NW
WASHINGTON, DC 200041109
TEL (202) 637-5600
FAX (202) 637-5910

*BY HAND DELIVERY*

Office of Premarket Approval
HFS-200
Center for Food Safety and Applied Nutrition
Food and Drug Administration
200 C Street SW
Washington, D.C. **20204**

**Re: GRAS Exemption Claim for Tasteless Smoke**

To Whom it May Concern:

On behalf of our client, Hawaii International Seafood Inc., Honolulu International Airport, P.O. Box **30486,** Honolulu, Hawaii **96820,** we submit this notification which contains data and information establishing that tasteless smoke is a generally recognized as safe (GRAS) food ingredient when it is used as a preservative to protect the taste, aroma and color of red-meat seafoods such as tuna and salmon. Enclosed for your review are an original, two copies and a redacted copy in which the confidential information has been removed, such as the manufacturing information, formulation (as expressed in terms of specifications) and other proprietary information.

Hawaii International Seafood has reviewed the available data and information on tasteless smoke and concluded that it is GRAS based on common use in food, and is, therefore, exempt from the premarket approval requirements of the Federal Food, Drug, and Cosmetic Act. The data and information supporting the GRAS status of tasteless smoke are summarized in the attached submission. Additional data and information supporting the GRAS status of tasteless smoke, including the raw data, will be made available for the Food and Drug Administration (FDA) review upon request.

If you have any questions, please contact me at the above phone number and address.

1998 MAR 29 P 12

985-0103

Martin J. Hahn

Enclosures

LET 5



BRUSSELS BUDAPEST LONDON MOSCOW PARIS* PRAGUE WARSAW
BALTIMORE, MD BETHESDA, MD COLORADO SPRINGS, CO DENVER, CO LOS ANGELES, CA McLEAN, VA
*Affiliated Office

\\\DC - 66887/1 - 0622187 03

ORIGINAL

# Hawaii International Seafood, Inc.
# GRAS Premarket Notification Summary
# For the Use of Tasteless Smoke
# In the Preservation of Seafood
# April 1998

## I. DESCRIPTION OF THE SUBSTANCE

### A. Common or Usual Name

The common or usual name is tasteless smoke. This is an appropriate name because this product is manufactured by filtering and purifying the same type of smoke that is used for conventional food smoking operations. The tasteless smoke is generated by combusting wood chips in contact with a heated surface, the smoke that is produced is then captured and run through a filtration and purification process that removes the particulate matter and many of the flavor components found in conventional smoke. Although filtered and purified smoke have been used for decades in the cold-smoking of fish, this process is unique in that conventional smoke is further purified and filtered to remove its primary flavor components.

### B. Chemical Name

There are numerous chemicals in tasteless smoke just as there are numerous different chemicals in smoke. The primary components in tasteless smoke are nitrogen ($N_2$), oxygen ($O_2$), carbon monoxide (CO), carbon dioxide ($CO_2$), methane ($CH_4$), aromatic phenols and hydrocarbons. Appendix 1 contains the results of the analyses that have been performed on tasteless smoke.

Appendix **2** identifies the constituents found in wood smoke and the ranges of their emission rates. 1/ The primary components of conventional smoke generated from wood are water vapor; carbon dioxide ($CO_2$); carbon monoxide (CO); methane ($CH_4$); tiny particulates of creosote, tar, soot; trace elements; and over **390** microscopic compounds occurring in either, or both, particulate and gaseous (vapor) phases. A comparison of Appendix **2** with Appendix **1** establishes that tasteless smoke contains the same components found in conventional wood smoke.

### C. CAS Number

There is no **CAS** number for tasteless smoke.

### D. Empirical Formula

There is no empirical formula for tasteless smoke per se. There are, however, empirical formulas for the constituents found in tasteless smoke. For example, the primary components in tasteless smoke are nitrogen ($N_2$), oxygen ($O_2$), carbon monoxide (CO), carbon dioxide ($CO_2$), and methane ($CH_4$). There are also trace levels of different aromatic phenols and hydrocarbons.

### E. Structural Formula

There also is no structural formula for tasteless smoke per se. As discussed, above, there are structural formulas for the primary components in the

---

1/ Larson and Koenig, *"A Summary of the Emissions Characterization and Noncancer Respiratory Effects of Wood Smoke,"* U.S. Environmental Protection Agency, EPA-453/R-93-036 (December **1993).**

tasteless smoke (*i.e.,* nitrogen ($N_2$), oxygen ($O_2$), carbon monoxide (CO), carbon dioxide ($CO_2$), and methane ($CH_4$)).

### F. Specifications for Food Grade Material

The following specifications are established for the tasteless smoke:

| **Component:** | **Range:** |
|---|---|
| Carbon Dioxide | **7-15%** |
| Carbon Monoxide | **7-30%** |
| Aromatic Phenols (gaseous vapor) | 10 ppb to 15.6 ppm |
| Hydrocarbons ($C_5$ to $C_{10}$) | 2000 to 6000 ppm (volume) |
| Hydrocarbons ($C_2$ to $C_4$) | 2000 to 6000 ppm (volume) |

The following additional process specifications are established to ensure that the tasteless smoke is used appropriately.

| **Process** | **Specification** |
|---|---|
| Combustion Temperature | <850 °F |
| Quality Grade (for Tuna) | Japan B grade (frozen sashimi tuna) |
| | No. 1 U.S. cooking grade (frozen tuna steaks) |

The specification for the combustion temperature has been established to reduce the formation of deleterious compounds in the smoke. The components found in smoke vary depending on the combustion temperature and amount of air intake. Appendix **3** shows the composition of wood smoke emissions at varying combustion temperatures. The formation of deleterious polynuclear aromatic hydrocarbons (PAHs) and the oxidation of organic vapors, including both condensable organic compounds as well as volatile organic compounds (VOCs) can be prevented by combusting below 850 °F (454 °C). Although most of these VOCs are removed by the filtration and purification process, the 850 °F specification is nonetheless established to minimize the formation of these undesirable compounds.

A specification also is established for the grades of tuna that are eligible for this process. This specification assures that only the higher quality tuna will be subjected to treatment with tasteless smoke. In addition, the grade of the tuna that is treated with the tasteless smoke is declared voluntarily on the label of the product.

### G. Quantitative Composition

A quantitative analysis of the components in tasteless smoke has been conducted by two independent laboratories and the table below summarizes the results. The table also shows the results from the analysis of raw, conventional smoke for purposes of comparison only.

| Component: | Lab 1 Percent | Lab 2 Percent* | Lab 2 Raw Smoke Percent" |
|---|---|---|---|
| Oxygen | **17.7** | 17.18** | **11.78**** |
| Nitrogen | Balance | **61.98** | **42.39** |
| Carbon Monoxide | 8.0 | **8.52** | **20.63** |
| Carbon Dioxide | 0.8 | **7.90** | **11.54** |
| Methane | **1.5** | **3.23** | **10.18** |
| Other Gases (hydrocarbons, etc.) | **<1** | N.A. | N.A. |
| Hydrogen | NA* | 1.2 | **3.49** |
| * Values are normalized to a 100 percent concentration<br>** Oxygen co-elutes with argon (atmospheric argon is **0.946%)**<br>NA = Not Analyzed | | | |

H. **Manufacturing Process**

Smoke is generated by burning an organic, food grade smoking material below 850 °F **(454** °C) in a smoke generator. 2/ This conventional smoke is then passed through filters of water and/or ice, cloth, and activated carbon. This filtration and purification process removes the taste imparting particulate and taste components and other vapors found naturally in the conventional smoke. The filtered smoke is then allowed to flow directly into a smoking chamber used to treat the seafood or it is collected and stored in canisters for treatment at another time.

The tasteless smoke is applied to the seafood at temperatures between 28 - 38 °F. More precisely, the tasteless smoke generally is applied at a

2/ Appendix **4** contains a chart identifying the typical wood fuel chemical analysis.

temperature range between the seafood's variable freezing point and 5 °F (2.8 °C) over that freezing point. The application levels for the tasteless smoke as expressed as a ratio of tasteless smoke volume (atmospheric pressure) to seafood volume are 1:1 to 100:1. The seafood is treated with the tasteless smoke until the desired effect is achieved which is usually between 12 to 54 hours.

The tasteless smoke treated seafood is then cryogenically frozen, and stored for up to one year. The treated product can be quick or slow thawed with little degradation of the taste, aroma, texture or color of the treated seafood.

## II. USE OF TASTELESS SMOKE

### A. Date When Use Began

#### 1. Conventional Smoke has been Used for Centuries.

Smoke has been used for thousands of years to preserve seafood. The preservation effect came from not only the components in the smoke, but also from the heating and drying associated with the smoking process. With the advent of refrigeration, the use of smoke as the primary means to preserve seafood became less important, although smoked seafood continues to have a longer shelf life than their non-smoked counterparts. 3/

---

3/ When in its raw state, seafood begins decomposition quickly at temperatures above 50 °F (10 "C). Seafood can be maintained fresh and unfrozen for two to three weeks at temperatures of 27 to 32 °F (-0.3 to 0°C) due to the salt content in the meat. However, decomposition is inevitable and rapid after this time period and other methods of freezing, canning, and smoking have been necessary to extend the shelf life of the food.

## 2. Filtered Smoke Has Been Used for at Least 90 Years.

The most important flavor components of smoke are reported as being monoaromatic phenols which occur in both the particulate and gaseous vapor phases. 4/ The phenols in the particulate phase have lower odor and taste recognition thresholds than the phenols in the gaseous vapor phase indicating that a smaller quantity of particulate is required to produce the same level of smoke odor and taste as the gaseous vapor phase. The particulate phase, however, contains high levels of pollutants including tar, soot, ash, and char, which make it less desirable for use on food.

The pollutants in the particulate phase of smoke are typically filtered while retaining the gaseous vapor phase for characteristic smoke flavoring. Many methods are used to filter out the tar, soot, ash, char and other microscopic particulates, such as tar settling systems, baffling systems, and washing systems in the line from the smoke generator to the smoking chamber. In addition, cooling and storage reduces the concentrations of phenolic particulate through settling. Some of these filtering methods remove substantially all the tar and particulate from wood smoke leaving only the gaseous vapor phase which produces the characteristic smoke flavor.

The filtering of smoke has been an integral part of the smoking process by some manufacturers for possibly as long as 90 years. A 1908 U.S. patent

---

4/ "*Smoke* in *Food Processing,*" Maga (1988), CRC Press, Inc.

discusses a device for curing edible matter comprised of a curing compartment, a smoke supply source, and a combined smoke cooling, purifying, and drying chamber where a portion of moisture and carbon soot condenses on the walls of the chamber. 5/ This method and apparatus manufactures purified smoke with substantially all odor and taste imparting particulate matter removed from the particulate phase of the smoke leaving only odor and taste imparting vapors. This patent establishes that purified smoke has been used in the food supply since well before 1958.

### 3. Filtered Smoke has been used on Raw Fish at Cold Temperatures for Over 70 Years.

Fish has been both hot and cold smoked for generations. A purified smoke has been used to cold smoke salmon in Europe and North America for decades. Salmon is treated with the purified smoke to preserve its color and texture and to impart a light smoke taste. Tasteless smoke is a super-purified version of the same purified smoke that has been used in salmon smoke houses for decades.

Although it is difficult to state precisely when the fish industry first used the cold smoking process, our review has established that this process has been practiced for over 70 years. For example, in the U.S. Pacific Northwest, Josephson's Smokehouse & Specialty Seafood Company has been cold smoking high quality Pacific Chinook Salmon since 1920. In Oregon, Sportsmen's Cannery & Smokehouse, established in 1955, utilizes a cold smoked process. In California, the

---

5/ U.S. Patent 889,828 to Trescott (1908).

Los Angeles Smoking & Curing Company (LASCCO) has been cold smoking seafood since 1921. All three of these examples of cold smoking of salmon prior to 1958 show the use of purified wood smoke to fix salmon color and texture. In addition, Josephson's and LASCCO have cold smoked albacore tuna as well. 6/

### 4. Conventional Smoke is GRAS.

Conventional smoke is generally recognized as safe (GRAS). Although FDA has not specifically listed or affirmed it as GRAS, FDA is not required to do so under the Federal, Food, Drug and Cosmetic Act. Indeed, FDA specifically recognizes in its GRAS regulations that it is "impracticable to list all substances that are generally recognized as safe for their intended use." 7/ The GRAS status of conventional smoke is supported by the numerous food standards and other **FDA** regulations that specifically recognize the use of smoke as an ingredient in foods. For example, the standard of identity for canned tuna specifically allows the product to be smoked. 8/

In addition, there are numerous cheese standards of identity that specifically, authorize for the smoking of cheese, including the standards for colby cheese, cold-pack cheese, cold-pack cheese food, pasteurized process cheese,

---

6/ *See* Appendix **6** for testimonials which establish that seafood companies have cold-smoked fish prior to 1958.

7/ 21 CFR § 182.1(a).

8/ 21 CFR § 169.190(a)(3)(v).

pasteurize process cheese food, pasteurized process cheese spread, and provolone. 9/ The GRAS status of conventional wood smoke is further supported by its listing as an approved ingredient that may be added to meat and poultry products. 10/

### 5. Tasteless Smoke, As a Component of Conventional Smoke, Has Been Used in Seafood, Since Prior to 1958.

Tasteless smoke is a component of conventional smoke. The tasteless smoke has merely been subject to physical purification and filtration processes that remove many of the flavor components and particulate matter from the smoke. Tasteless smoke, therefore, has been present in the food supply as a component of conventional smoke, for centuries.

## B. Tasteless Smoke is GRAS Based On Common Use in Foods

Tasteless smoke is GRAS based on common use in foods because it is a component of conventional smoke which has been applied.to seafood for thousands of years. In addition, conventional smoke has been purified and filtered prior to its application on seafood for at least 90 years.

The GRAS status of tasteless smoke is further supported by the practice of cold smoking tuna and salmon with a purified smoke for purposes of preserving the taste, aroma and texture of the product. This practice has been used in the seafood industry for at least 70 years and the tasteless smoke is applied in a

---

9/ 21 CFR § § 133.118(d)(1), 133.123(b)(1), 133.124(b), 133.169(b), 133.173(b), 133.175(b) and 133.181(a)(3), respectively.

10/ 9 CFR §§ 318.7(c)(4), 381.147(c)(4).

e similar manner and for a similar intended use (*i.e.,* it is applied at cold temperatures for the purpose of preserving the taste, aroma and texture). The tasteless smoke manufacturing process merely represents a further extension of the purification and filtration that has been done for decades to conventional smoke.

**1. Experts have reviewed the data on tasteless smoke and concluded that it is GRAS.**

Dr. Joseph Maga, Director of the Department of Food Science and Human Nutrition at Colorado State University has reviewed the tasteless smoke process and concluded that tasteless smoke is GRAS. Dr. Maga offered the following comments in this regard:

> The use of various smoke preparations (smoke vapor, liquid smoke extracts) have been routinely used in food preparation for centuries / decades. In most operations the particulate phase in both gaseous and liquid smoke preparations is routinely removed by various physical means such as filtration, sedimentation, and electrostatic precipitation to name a few. Your "Tasteless" smoke purification is simply an extension of traditional smoke purification. The resulting product does not have anything added and all components present in the product were originally present in smoke.

Additional experts in the area of smoking technology also have reviewed the process and concluded that tasteless smoke is GRAS. The letters from these experts can be found in Appendix **6.** The names, addresses and titles of the experts who have reviewed the process and concluded that tasteless smoke is GRAS are identified below:

Dr. Joseph Maga
Director
Department of Food Science and Human Nutrition
Colorado State University
Fort Collins, Colorado 80523-1571

Dr. Steven D. Hoyt
President
Environmental Analytical Services, Inc.
**3421** Empresa, Suite A
San Luis Obispo, California **93401**

Robert Hanson
Technical Director
Alkar, Inc.
**932** Development Drive
P.O. **Box 260**
Lodi, Wisconsin *53555*

**2.** Tasteless smoke does not present the potential health risks **of** conventional smoke because the carcinogenic impurities are filtered out and removed.

FDA recognizes that conventional smoke can be a source of carcinogenic impurities such as Benzo[a]pyrene (BaP) and other polynuclear aromatic hydrocarbons (PAHs). 11/ Tasteless smoke does not present the same potential health risks of conventional smoke because carcinogenic impurities are filtered out and removed. The super-purifying process of producing tasteless smoke removes any remaining particulate matter from the particulate phase and reduces the phenolic level of the gaseous phase below the odor and taste threshold. 12/ This manufacturing process, which involves the cooling of the smoke, washing of the smoke, and filtering of the smoke, reduce the PAH levels below those found in traditional smoke.

---

11/ Food Additives Analytical Manual -- Volume 11, "Polynuclear Aromatic Hydrocarbons" **(1987).**

121 The odor threshold for the vapor in smoke is **10.4** ppm, while the taste threshold is **2.3** ppm. Daun, H., Lebensm, Wiss. Technol. **5,102 (1972).**

000014

### C. Intended Use

The tasteless smoke is intended to be used on raw red-meat seafood, such as tuna and salmon, before it is frozen. The tasteless smoke is added to preserve the taste, aroma, texture and color of the frozen seafood. As will be discussed in more detail below, without the addition of tasteless smoke, frozen tuna and other red-meat seafood is prone to browning, the development of off odors and decreased palatability during freezing.

### D. Limitations

The following limitations are established to ensure that the tasteless smoke is used in accordance with good manufacturing practices.

| **Limit of Use:** | **Level/Range:** |
|---|---|
| Treatment Exposure Time | 12 to **54** Hours |
| Quantity of Tasteless Smoke Applied (Expressed as Ratio of Seafood Volume to Tasteless Smoke Volume--atmospheric pressure) | 1:1 to 100:1 |
| Treatment Temperature | 28 to **38 °F** |

## 111. EFFICACY DATA

### A. Background

#### 1. Color Physiology

The pigments in meat and in some species of seafood, such as tuna, consist largely of two proteins: hemoglobin, the pigment of the blood, and myoglobin, the pigment of the muscles. In well bled muscle tissue, up to 80 to 90 percent of the total pigment is myoglobin. The myoglobin molecule contains a globular protein portion (*i.e.,* globin) and a nonprotein heme ring. The heme ring contains an iron ion. The color of the heme ring and of the myoglobin molecule, is partially dependent on the oxidative state of the iron within the heme ring.

The quantity of myoglobin within the tissue and the intensity of the color varies depending on species, age, sex, muscle and physical activity. Species differences are apparent when comparing the lighter color of swordfish with the dark red color of tuna or the lighter color of pork with the darker color of beef. The impact of age is most apparent by comparing the lighter color of veal with the darker color of beef. There are also differences within species in that some tuna will have a higher quantity of myoglobin in the muscle tissue than other tuna. These intraspecies differences account for the variability in color of tuna steaks that are cut from different fish.

The color of the meat is affected by the quantity of myoglobin in the tissue and by the oxidative state of the iron in the myoglobin. When the meat is first cut, the flesh has a dark red almost purple color, which is the color of myoglobin. The myoglobin easily reacts with the oxygen in the air and forms oxymyoglobin which has a bright red color. When the oxymyoglobin is held in a conventional frozen environment, the iron ion in it is prone to oxidation and forms metmyoglobin, which has an undesirable brown color. The oxidized iron can also adversely effect the taste and smell of the product in that it leads to the oxidation of unsaturated fatty acids in seafood, thus generating volatile organic compound gases that produce undesirable smells and flavors.

The myoglobin can combine with substances other than oxygen and form compounds that are more stable at conventional frozen temperatures than oxymyoglobin. Of primary importance here are the reactions between myoglobin and the components in conventional smoke and tasteless smoke, carbon monoxide, nitric oxide, and nitrogen dioxide. In the presence of smoke and tasteless smoke, the myoglobin will form carboxymyoglobin, nitric oxide myoglobin, or nitrogen dioxide myoglobin, all of which are red.

The common curing agents, nitrates and nitrites, are sources of nitric oxide and lead to the formation of nitric oxide myoglobin. Accepted methods of curing fix color and preserve freshness, in part, by preventing oxidation of the oxymyoglobin into metmyoglobin. It is the FDA position that substances which "fix" or stabilize an existing color rather than add new colors are not color additives. This position is well settled and has been upheld by the courts.13/

### 2. Impact of Freezing on Color of Fish

Freezing has an adverse impact on the color of tuna and other species of fish. The environment of conventional freezers with temperatures between 0 and -30°F (-18 to -34° C) facilitates the development of metmyoglobin in frozen tuna and other species of fish. Observable browning in frozen tuna is generally noticed

---

13/ *Public Citizen v. Hayes,* Food Drug Cosm. L. Rep. (CCH) ¶ **38,161** (D.D.C. **1982)** (nitrites "fix" the red color of meats and therefore are not color additives).

000017



\\\DC - 66887/1 - 0601858 01

after two months of freezing. 14/ The oxidation of the oxymyoglobin into metmyoglobin decreases the acceptability of the frozen tuna because of the undesirable off-brown color and of the off-odors that develop. Consequently, frozen red meat fish distributed in the United States is prone to the adverse effects of oxidation unless it has been treated to prevent such oxidation.

The oxidation of the oxymyoglobin can be prevented by maintaining the frozen seafood at super cold freezing temperatures below **-76** °F. The use of these super cold temperatures is common in Japan which has an infrastructure that utilizes super cold freezers in the manufacturing and distribution system. Holding sashimi tuna at these super low temperatures is very effective in maintaining the natural bright red color of the flesh for **up** to one year. This technology is not widely utilized in the United States and the current processing and distribution channels lack the capabilities to maintain seafood at temperatures below -76 °F. Millions of dollars would be needed to upgrade the existing freezers in the distribution system with supercold freezers,. Given the prohibitively expensive investment needed to upgrade the freezers and the undesirable color, taste and aroma of tuna that has been frozen for over two months, the U.S. seafood industry has been limited to using fresh seafood for sashimi and either fresh or frozen seafood with an undesirable color and flavor for cooking.

---

14/ Maga, Color Properties Test Results for Untreated Two Month Frozen and Thawed Tuna Samples (Appendix **11).**

### 3. Benefits of Conventional Smoke and Tasteless Smoke

The components in conventional smoke fix the color of the seafood by reacting with the myoglobin to form compounds that are more stable at conventional frozen temperatures than oxymyoglobin. The carboxymyoglobin, nitric oxide myoglobin and nitrogen dioxide myoglobin form when conventional smoke is used to treat seafood. Because these forms of myoglobin are much more stable in a conventional freezer environment than oxymyoglobin, frozen smoked seafood will not experience the browning that is associated with its unsmoked counterpart.

Conventional smoke, however, imparts a characteristic smoke flavor which impacts the taste of the seafood product. The smoke taste makes conventional smoking an undesirable process for preserving the color, taste, texture and aroma of frozen seafood. Tasteless smoke provides a desirable alternative because it offers the preservative benefits of conventional smoke without the conventional smoke taste.

The treatment with tasteless smoke, like conventional smoke, results in the formation of carboxymyoglobin, nitric oxide myoglobin and nitrogen dioxide myoglobin. Unlike oxymyoglobin, these compounds are more stable in a frozen environment and do not lead to the formation of metmyoglobin or facilitate the oxidation of unsaturated fatty acids which generate off odors. It is important in cold smoking to keep the meat raw and uncooked to maximize the amount of vital cells available for this reaction.

For example, salmon that is cold smoked using purified wood smoke and vacuum packed can be refrigerated for several months without any decomposition or development of off odors. Similarly, tasteless smoke treated tuna can be frozen for several months without any decomposition or undesirable "freezer" smells. The organoleptic "sniff test" shows significant retardation of decomposition of cold smoked product high in carboxymyoglobin.

### B. Tasteless Smoke Has a Preservative Effect on the Taste and Texture of the Frozen Tuna When it is Subsequently Thawed.

One of the most important qualities of a food is its taste. Texture and aroma are primary attributes of taste and tests have demonstrated that tasteless smoke has a preservative effect on the texture and aroma of treated products.

#### 1. Tasteless Smoke Preserves Texture.

Tasteless smoke has been demonstrated to increase the tenderness of raw and cooked tuna that have been frozen and thawed when compared to untreated frozen and thawed tuna. Dr. Maga states that

> toughness deals with resistance of fibular protein to cutting where as firmness deals with resistance to pressure, including setting back. Cooking will denature protein making it tougher. More protein/myoglobin denaturation would occur in untreated flesh than treated thereby influencing toughness. Tenderness would be considered to be its attribute because it would be associated with product juiciness.

Dr. Maga performed the texture analysis by using an Allo-Kramer shear press to measure textural properties of random samples from within each group for both raw and cooked (broiled) product. Three groups were tested: **(1)** tuna treated with tasteless smoke, (2) tuna treated with raw smoke, and **(3)** untreated tuna. The tuna were frozen and stored for either two or six months. The larger the number, the tougher the product. Conversely the smaller the number the more tender the product. 15/ The following table summarizes these results:

| Texture Results for Raw and Cooked Tuna | | | | |
|---|---|---|---|---|
| | Frozen for 2 Months | | Frozen for Six Months | |
| | Raw | Cooked | Raw | Cooked |
| Untreated | **6.91** | **7.23** | **6.53** | **6.90** |
| Tasteless Smoke Treated | **6.60**<br>**6.33** | **6.98**<br>**6.57** | **6.28** | **6.63** |
| Conventional Smoke | **6.37** | **6.60** | **N.A.** | **N.A.** |
| **N.A.** = Not **Analyzed** | | | | |

These results show that tasteless smoke treated samples were consistently more tender and juicy, both raw and cooked, than the untreated samples in both two and six month tests. In addition, there was no apparent difference in raw and cooked texture between the raw smoke and tasteless smoke treated samples further demonstrating that tasteless smoke and conventional smoke have comparable effects on texture.

**2. Tasteless Smoke Preserves Aroma.**

Dr. Maga measured aroma intensity and did not attempt to distinguish between off-odor (fishy) or desirable aromas. He utilized a trained ten-member sensory panel of *six* females and four males in an age range of 19 to 58. This group scored raw and cooked (broiled) samples on a 10-point aroma intensity scale with one being bland and **10** being strong. 16/ The following table and chart summarize these results (lower numbers are considered more desirable):

---

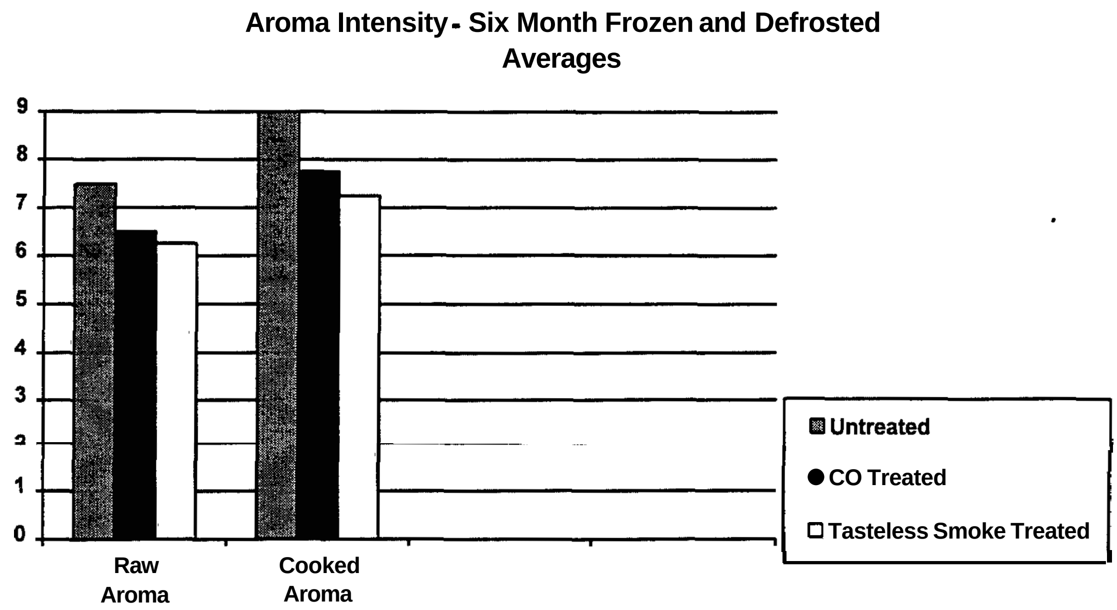
15/ Appendix **7** contains the test results.

16/ ***See*** Appendix 8 for the test results.

| Aroma Results for Raw and Cooked Tuna | | | | |
|---|---|---|---|---|
| | Frozen for 2 Months | | Frozen for Six Months | |
| | Raw | Cooked | Raw | Cooked |
| Untreated | 6.00 | 6.88 | 7.50 | 9.00 |
| Tasteless Smoke Treated | 5.25<br>5.33 | 6.13<br>6.33 | 6.25 | 7.25 |
| Conventional Smoke | 5.33 | 6.33 | N.A. | N.A. |
| Carbon Monoxide | 5.00 | 6.00 | 6.50 | 7.75 |
| N.A. = Not Analyzed | | | | |

These results show that the aroma of the untreated samples were consistently stronger both raw and cooked than the aroma of samples treated with carbon monoxide and tasteless smoke in both two and six month tests. Furthermore, there was little difference between raw smoke and tasteless smoke treated samples. In all cases cooked samples had a stronger aroma intensity than raw samples.

Interestingly, as illustrated by the chart below, the aroma of *six* month samples treated with carbon monoxide was considerably stronger both raw and cooked than the aroma **of** *six* month samples treated with tasteless smoke.




This is a shift from the two month samples in which the carbon monoxide treated samples had a lower aroma, although to a much lesser degree. These data indicate a unique property of tasteless smoke in better preserving aroma during longer term frozen storage. Tasteless smoke treatment, therefore, influences tuna aroma differently than either carbon monoxide treatment or no treatment and has a preservative effect by preventing the development of strong fish odors during freezing. It is postulated that these preservative effects are due in part by preventing the oxidation of the iron ion in the myoglobin. 17/

17/ ***See*** *also* Judge, Aberle, Forrest, Hedrick and Merkel, "Principles of Meat Science" (undesirable odors can be prevented by immobilizing the iron atom in myoglobin).

## C. Antimicrobial and Antioxidative Properties of Tasteless Smoke.

Tasteless smoke also offers anti-microbial and antioxidative properties. Preservation results both from a reduction of microbial counts during smoking and an extension of the shelf life of the treated fish. Conventional smoke contains numerous compounds with antioxidant-properties such as pyrocatechol, hydroquinone, guaiacol, eugenol, isoeugenol vanillin, salicylaldehyde, 2-hydroxybenzoic acid, and 4-hydroxybenzoic. 18/ These antioxidative phenolic derivatives will retard lipid-associated rancidity in seafood.

According to **Dr.** Maga, "any phenolic that can produce a quinid structure will demonstrate some degree of [antioxidative] functionality." 19/ Tasteless smoke contains aromatic phenols, albeit at concentrations below the taste and odor threshold, and they will demonstrate antioxidative functionality.

Tasteless smoke also has a preservative effect by lowering the pH of the fish. The carbon monoxide and carbon dioxide in the tasteless smoke react with the water naturally present in the seafood to form carbonic acid. Even small pH changes can **be** significant and result in an increase in shelf life. **A** study analyzed the effect of tasteless smoke on the pH of seafood and the results are summarized in the table below. 20/

---

181 Toth, ***"Smoke-relatedphenolic compounds withproven antioxidative properties,"*** Advanced Food Rest., **29,** 87, (1984).

19/ Maga, ***'Smoke** in Food **Processing,"*** Chapter 7.

201 ***See*** Appendix **9,** "pH Measurements Tests."

| pH of Seafood Frozen for Two Months | |
|---|---|
| Untreated | 5.97 |
| Tasteless Smoke Treated | 5.95 |
| Conventional Smoke Treated | 6.10 |
| Tasteless Smoke Treated | 6.06 |

These data show that, in all cases among species, each tasteless smoke treated sample was more acidic than either an untreated sample or a conventionally smoked sample cut from the same fish.

### D. Tasteless Smokes Fixes Color.

Tasteless smoke also has a preservative effect in that it maintains the color of the seafood during frozen storage. Tasteless smoke "fixes" the color of tuna and other red-meat seafood in the same way that nitrates and nitrites fix the color of cured meats (*i.e.,* by reacting with the myoglobin to form compounds other than oxymyoglobin).

Just as the resulting color of pork treated with nitrates differs slightly from the uncured color, the color of red-meat seafood treated with tasteless smoke differs slightly from the untreated color. 21/ The difference in color is primarily attributable to an increase in the yellowness of the sample, although there are also subtle differences in the redness and lightness. The slight yellowing of treated seafood parallels a slight increase in the yellow component of untreated seafood that occurs naturally during the freezing and thawing process.

---

21/ ***See*** Appendix 10, "Untouched Color Photographs," which shows the color of treated and untreated samples.

An independent laboratory measured the effect of tasteless smoke on the color of tuna and other red-meat seafood. Using a Hunter Lab Color Difference Meter, the laboratory measured the lightness, yellowness and redness of **147** samples of untreated, tasteless smoke treated, and carbon monoxide treated fish that had been frozen and stored for either *six* or two months. The laboratory measured the color of the samples after they had been thawed in a refrigerator for 24 hours. The same samples were then placed in household resealable bags and held at **4°C** for five days and the color measurements were repeated.

The samples were taken from yellowfin, bigeye, and albacore tuna, and salmon of varying sizes and grades typically used to produce products for the U.S. market. The color properties of five fresh chilled tuna (three yellowfin and two bigeye) of varying weights and grades were also tested to demonstrate the impact of tasteless smoke on the color of the product. 22/ The results from the analysis are summarized below:

### 1. Lightness

Lightness values, which measure the intensity of the color, were lower for tasteless smoke treated frozen and defrosted tuna samples than for either carbon monoxide or untreated frozen and defrosted samples. The tasteless smoke treated samples had the lowest color "intensity" ratings of the previously frozen samples tested.

---

22/ See Appendix 11, "Data of Color Properties Test Results," for the color test results.

| Product | Lightness | |
|---|---|---|
| | **Day 1** | **Day 5** |
| Fresh Tuna | 80.26 | **N.A.** |
| Untreated Tuna (Frozen **2** Mths) | **80.55** | 81.10 |
| Tasteless Smoke Treated (Frozen **2** Mths) | 80.49 | 80.72 |
| CO Treated (Frozen 2 Mths) | 80.74 | 80.88 |

### 2. Yellowness

**A** natural "yellowing" occurs in frozen and defrosted untreated tuna and other species as evidenced by a ***58*** percent increase in yellowness values. The treatment with tasteless smoke does not prevent this "yellowing" as the yellowness value of the tuna steak continues to increase for the tasteless smoke treated product during storage at frozen temperatures. The frozen and thawed tasteless smoke treated sample is slightly more yellow in color than the untreated frozen and thawed sample and significantly more yellow than the untreated fresh sample.

| Product | Yellowness | |
|---|---|---|
| | **Day 1** | **Day 5** |
| Fresh Tuna | +0.50 | **N.A.** |
| Untreated Tuna (Frozen **2** Mths) | +0.79 | +0.38 |
| Tasteless Smoke Treated (Frozen **2** Mths) | +0.85 | +0.50 |
| CO Treated (Frozen **2** Mths) | +0.95 | +0.83 |

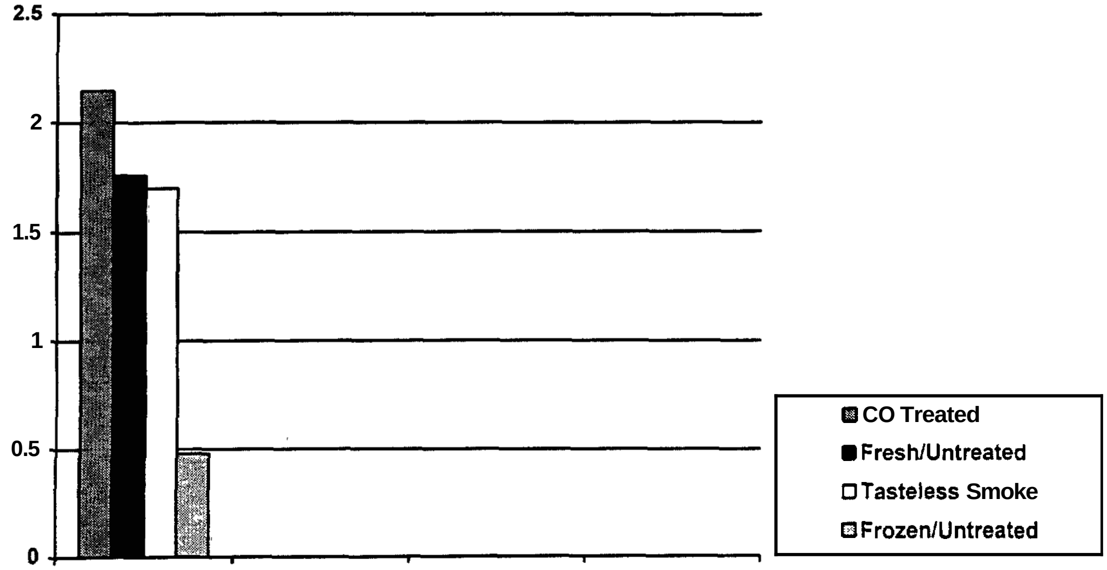
### 3. Redness

The redness of tuna is an important characteristic because a darker, redder color is considered more desirable by consumers. The following tables summarize test results for carbon monoxide treated, tasteless smoke treated and untreated yellowfin and bigeye tuna steaks that had been frozen for two months. These frozen samples were thawed and their red color was compared to that of fresh tuna steaks.

| Comparison of Average Redness Values for Frozen and Thawed Tuna (1 and 5 Days) with Fresh Tuna | | |
|---|---|---|
| **Product** | **Redness** | |
| | **Day 1** | **Day 5** |
| Fresh Tuna | **1.76** | **N.A.** |
| Untreated Tuna (Frozen **2** Mths) | **0.48** | **0.31** |
| Tasteless Smoke Treated (Frozen **2** Mths) | **1.70** | **1.47** |
| CO Treated (Frozen **2** Mths) | **2.15** | *2.00* |

After two months of frozen storage and **24** hours of thawing, tasteless smoke treated tuna has an average redness measurement of **1.70** which is approximately the same as the **1.76** average measurement for the fresh untreated tuna fillet. (The average redness is also **1.70** for tasteless smoke treated tuna that have been frozen for six months and thawed.) The carbon monoxide treated tuna average score of **2.15** shows that carbon monoxide, unlike tasteless smoke, substantially increases (*i.e.* by **24** percent) the redness of tuna steaks. The untreated sample had the lowest redness ratings which demonstrates the adverse impact that two months of freezing has on the redness of tuna. These results are summarized in the chart below:

Red Color Values - Day One
Yellowfin and Bigeye Tuna




The redness of the tasteless smoke treated product, however, declines once the product is thawed. The average redness measurement for tasteless smoke treated tuna declines **14%** over five days of refrigeration while the average measurement for carbon monoxide treated tuna declines 7% over the same period. This carbon monoxide treated tuna still remains in an enhanced state, **14%** redder on its fifth day than fresh tuna on its first day. While individual sample measurements will vary with species and grade, the overall average of a large sample size will consistently show carbon monoxide treated tuna at an enhanced level of redness and tasteless smoke treated tuna at a comparable level of redness to fresh tuna.

Dr. Maga concludes in his report on color measurement that

> all carbon monoxide treated samples were redder in color than untreated and tasteless smoke treated samples, with the untreated samples the darkest in color. With storage, the carbon monoxide

treated samples held more red color, the untreated samples lost the most color, and the tasteless smoke treated samples were in between.

He adds that there were "some differences among fish types, no differences between fish loins or fish fillets..." The data also showed that higher grades of fish displayed higher color values.

These test results show that treatment with tasteless smoke as applied "fixes" the red color characteristic at its fresh level until thawing at which point a natural fading occurs during refrigerated storage. Treatment with carbon monoxide "enhances" the red color characteristic of equivalent samples throughout the freezing, thawing, and storing process until used with less degradation of this enhanced color.

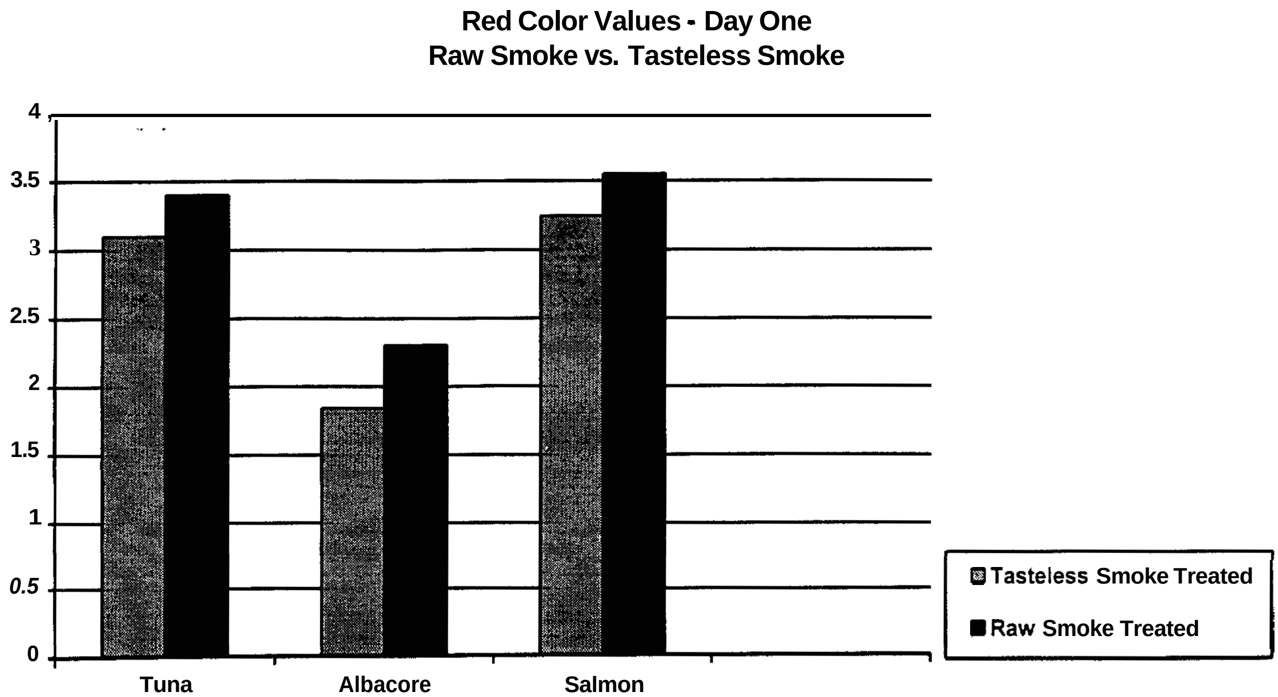
Tasteless smoke also has the same general effect on salmon, which has been cold smoked in Europe and North America for decades. Tasteless smoke is a super-purified version of the same purified raw smoke that is used in salmon smoke houses to treat and preserve the color and texture of salmon. These data show that without tasteless smoke treatment the color degrades in the frozen state and continues to fade more rapidly after thawing than tasteless smoke treated samples. Thus, using the same ingredient and means of treatment for salmon as tuna produces the same results of color "fixing" and preservation.

| Redness Results for Salmon (Compared to Fresh/Unfrozen) | | | | | | |
|---|---|---|---|---|---|---|
| | Thawed 1 Day | | | Thawed 5 Days | | |
| | High | Low | Avg | High | Low | Avg |
| Untreated | 3.20 | 3.10 | 3.15 | 2.80 | 2.70 | 2.75 |
| Tasteless Smoke Treated | 4.00 | 3.50 | 3.75 | 3.80 | 3.30 | 3.55 |
| Carbon Monoxide Treated | 4.40 | 4.30 | 4.35 | 4.20 | 4.20 | 4.20 |

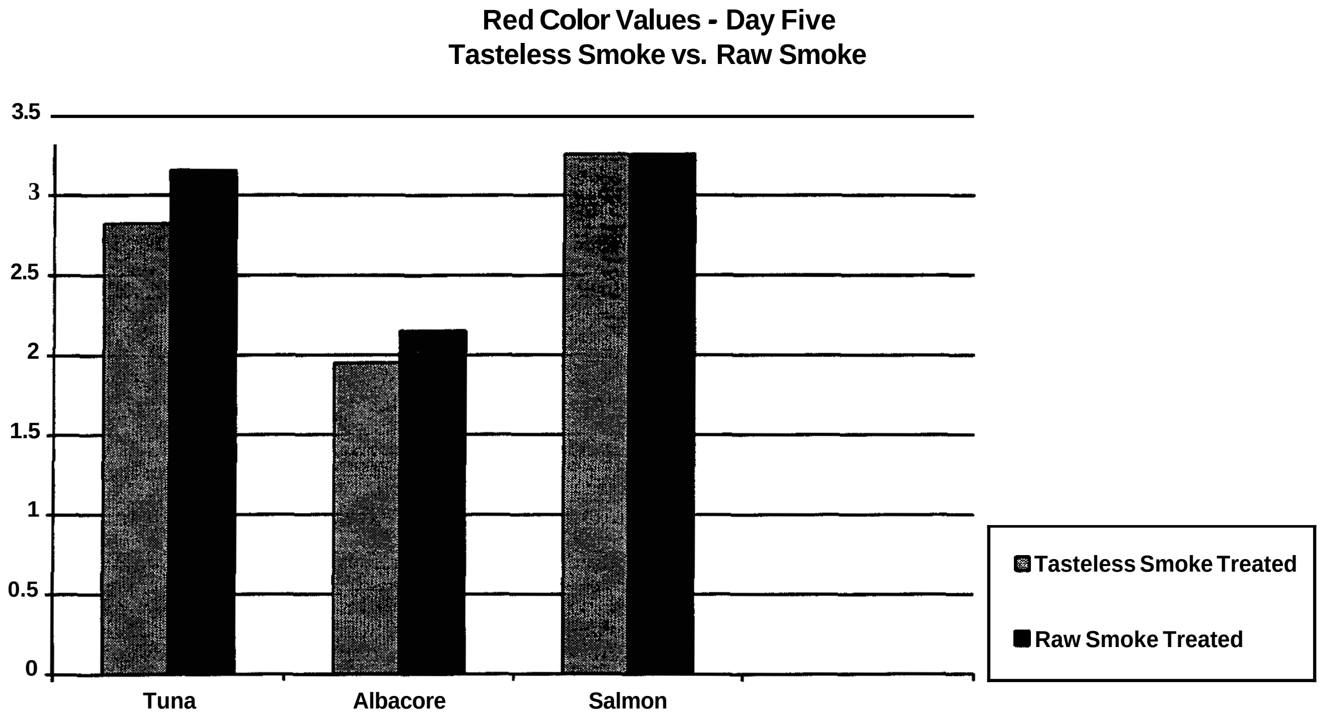
### E. The tasteless smoke has the same general effect on the color as conventional smoke.

Tasteless smoke has the same general effect on the color of seafood as conventional smoke. Dr. Maga used the Hunter Lab Color Difference Meter to test the hypothesis that raw smoke and tasteless smoke behave similarly as ingredients in the treatment of seafood. These results, as illustrated in the chart below, consistently showed the raw smoke treated samples to be redder than the super-purified tasteless smoke treated samples for all species. 23/

23/ *See* Appendix 12, for the test results.




The results further showed a natural fading of red color over the five day storage period for both raw smoke and tasteless smoke treated samples as illustrated in the chart below.




These tests used a higher grade of tuna, Japan "A" grade, than the other tests which used a Japan "B" grade or "#1" cooking grade. The higher grades of tuna have more vital myoglobin cells which would more easily discern any differences between raw smoke and tasteless smoke. The comparison of raw smoke with super-purified tasteless smoke treated samples shows that super-purification does not increase color imparting attributes from raw smoke levels. On the contrary, "super" filtering reduces the color imparting attributes of the resultant tasteless smoke from raw smoke levels.

### F. Tasteless Smoke is Different than Carbon Monoxide

Last summer the Office of Seafood at FDA released a letter to the seafood industry in which the agency took the position that carbon monoxide could not be used in the treatment of raw tuna because it is an unapproved food additive and because it economically adulterates the product. Since issuing that letter, Hawaii International Seafood has met with individuals in the Office of Seafood to clarify the distinctions between tasteless smoke and carbon monoxide. As part of that meeting, FDA asked for data demonstrating that carbon monoxide and tasteless smoke have a different functional effect when added to food. The following studies, in addition to the color studies discussed previously, establish that this is the case.

### 1. Tasteless smoke has a different effect on the color of tuna than carbon monoxide.

Samples of yellowfin and albacore tuna were treated with tasteless smoke, treated with carbon monoxide, and frozen and thawed. An independent laboratory convened a focus group which was asked to rate the quality of various characteristics 24 hours after thawing and 72 hours after thawing. 24/

The focus group reported that 24 hours after thawing, the carbon monoxide treated yellowfin was rated "bright unnatural red" while the tasteless smoke treated yellowfin was "natural red" and not as bright as carbon monoxide treated. After 72 hours, the carbon monoxide treated yellowfin was "slightly faded, but still bright unnatural red," while the tasteless smoke treated yellowfin was "slightly faded no longer a sashimi red."

*

24/ *See* Appendix **13,** for the test results.

There is little change in color of yellowfin tuna treated with tasteless smoke compared with its fresh untreated state, while there is **a** substantial bright unnatural red-pink color of the same tuna treated with carbon monoxide. Further, the tasteless smoke treated yellowfin and albacore tuna fade naturally with time after thawing while the carbon monoxide treated samples retain substantially all of the bright unnatural color.

**2. Tasteless smoke treated tuna has a different taste than carbon monoxide treated tuna.**

Raw and cooked tasteless smoke treated yellowfin and albacore tasted similar to fresh after thawing. Raw carbon monoxide treated yellowfin and albacore exhibited a flat "plastic" taste, while cooked carbon monoxide treated product did not have much flavor. Those in the focus group panel by far preferred the cooked tasteless smoke treated yellowfin as the best of all the samples exhibiting a rich, full fresh-like taste.

**3. Tasteless smoke treated tuna has a different texture than carbon monoxide treated tuna.**

The focus group panel was asked to rate the firmness, or resiliency, of the samples. Here the untreated sample displayed significant softness and moisture loss after thawing. By comparison, the carbon monoxide treated samples were very firm with little moisture loss and the tasteless smoke treated samples were slightly softer with more moisture loss. After three days the carbon monoxide treated samples were still firm while the untreated and tasteless smoke treated samples were softer. The tasteless smoke treated tuna retained more of the firmness of fresh tuna than the untreated tuna, yet degraded naturally after thawing.

### 4. Tasteless smoke treated tuna has less residual carbon monoxide in the flesh than carbon monoxide treated tuna.

As discussed earlier, seafood treated with raw smoke or tasteless smoke has myoglobin molecules with open receptors that undergo a chemical reaction with a variety of compounds present in the smoke--carbon monoxide, nitrous oxide, nitrous dioxide--that stabilizes the myoglobin iron and keep it from oxidizing. Different species, and different grades of different species, have different amounts of vital myoglobin cells available for such reactions. This can be viewed as the capacity, or potential for color reaction. Species and grades with a higher capacity will have proportionately higher saturations. This is readily apparent in the grading of fresh tuna. The greater the number of myoglobin molecules, the greater the capacity for oxygen color reaction as oxymyoglobin. The more the saturation of oxymyoglobin, the redder the fresh meat.

Treatment with either chemical carbon monoxide gas or tasteless smoke will result in a saturation of a portion of the capacity for color reaction of the myoglobin molecules into carboxymyoglobin. It is not possible to establish a maximum level of residual carbon monoxide per kilogram of fish since carbon monoxide saturation will be higher for higher grades and for certain species given identical treatment procedures. However, it is possible to compare residual carbon monoxide levels of chemical carbon monoxide treated versus tasteless smoke treated identical samples. 25/

| Residual Carbon Monoxide Levels (micrograms per kilogram) | | | | | | |
|---|---|---|---|---|---|---|
| | Lab 1 | | | Lab 2 | | |
| | High | Low | Avg | High | Low | Avg |
| Untreated | 49 | 30 | 39 | 56 | 8 | 29 |
| Tasteless Smoke Treated | 1400 | 400 | 768 | 416 | 101 | 243 |
| Carbon Monoxide Treated | 2100 | 240 | 1142 | 682 | 76 | 371 |

On an absolute level the measurements by the laboratory number 1 are 2.5 times higher than the measurements of laboratory number 2. These differences may be attributable to equipment, testing procedures, and/or the capacity of the varying grades and species. More importantly, on a comparative level, both laboratories showed that carbon monoxide treated tuna showed about 50 percent higher average residual carbon monoxide levels than tasteless smoke treated tuna.

### G. Other Benefits of Tasteless Smoke Treated Tuna

#### 1. The use of tasteless smoke enables the food industry to comply with public health recommendations against eating raw fish unless it has been previously frozen.

There is an increasing concern among FDA and other public health authorities regarding the safety of consuming raw, unprocessed seafood because of possible parasite infestation. The 1997 Food Code requires raw, marinated, or partially cooked fish to be frozen to ensure destruction of parasites. The Food Code

25/ *See* Appendix **14,** "Residual CO Level Test Results," for the data.

000037

specifies that the fish should be frozen throughout at a temperature of -20°C for seven days or - 35°C for 15 hours in a blast freezer. The Food Code is a model code published by **FDA** that is intended to serve as the framework for local and state ordinances regarding the handling of food in restaurants and retail stores. Although the Food Code is not a federal law, some state and local jurisdictions incorporate all of its provisions into their statutes and ordinances.

Implementing the Japanese method of super cold freezing (-76°F or less) (-60°C or less) and storage to preserve color and kill parasites is impractical in the U.S. because of the retrofitting and capital investment required. It would cost millions of dollars to add super cold freezers to every cold storage facility, seafood distributor facility, restaurant, sushi bar, and supermarket across the U.S. Because of this high cost relative to the size of the U.S. market, super freezers are not a practical solution.

It is our understanding that many sushi establishments and other restaurants that serve raw fish dishes are reluctant to comply with the 1997 Food Code recommendation because frozen fish frequently lacks the taste, texture and appearance of fresh fish. The tasteless smoke treated product, however results in a product that is comparable in taste, texture, appearance and overall palatability to the'non-frozen tuna. The use of tasteless smoke, therefore will prove valuable in helping restaurants comply with the 1997 Food Code and with the recommendations of FDA and other public health officials regarding the freezing of seafood that is to be consumed raw.

### 2. The use of tasteless smoke has economic advantages in that frozen seafood can be transported much less expensively than fresh seafood.

The consumer is also receiving an economic benefit because frozen tuna steaks are much less expensive than fresh steaks primarily due to the cost differences between air freight and ocean freight. Fresh fish is typically air freighted from Pacific fisheries to the U.S. on ice in H & G form (whole with the head and gills removed). The average cost of such air freight is $1.92/lb. Generally, 53% of this fish will be lost during filleting so the per pound air freight, where calculated on the basis of the edible tuna, increase to $4.09/lb. In contrast, the tasteless smoke treated products are cut into steaks or fillets near the Pacific fisheries and treated with the tasteless smoke and frozen. The frozen fillets and steaks are shipped via ocean liners to the U.S. at a cost of about $0.19/lb. Although the tasteless smoke technology will add some costs to the raw tuna, the savings in air freight far exceeds these costs, so the economic savings could be passed onto the consumer in the form of lower seafood prices.

For example, fresh Indonesian tuna is delivered to master distributors in the U.S. at an average price of $3.35/lb. It will cost each U.S. distributor approximately $.17/lb. of H & G tuna to fillet into steaks. After filleting loss of 53% of the unused fish, the yielded fresh steak cost is $7.50/lb. Hawaii International Seafood, Inc. will deliver the exact same grade of frozen tuna steak, treated with tasteless smoke, **for** $4.95/lb. ***to*** the master distributor. **This** is **a** savings to the consumer of $2.55/lb. at the master distributor level.

In addition, the retailer has the added benefit of being able to stock frozen inventory and thaw out only what is needed on demand, thus avoiding the degeneration of quality associated with aging fresh seafood. This allows the retailer to maintain a consistent, high quality, "previously frozen" tuna steak supply available for his customers while reducing losses to spoilage.

## IV. METHODS FOR DETECTING THE SUBSTANCE IN FOOD

There is not a method for detecting the presence of the ingredient tasteless smoke in food. There are methods, however, which can be used to detect for the presence of the components of tasteless smoke, such as the nitrogen, oxygen, carbon monoxide, carbon dioxide, methane, aromatic phenols and hydrocarbons. These methods are as foluows:

| Component: | Method Number | Abbreviated Method Name |
|---|---|---|
| Carbon Dioxide | ASTM D1946 | Analysis of Reformed Gas by Gas Chromatography (GC) with Thermal Conductivity Detection (TCD) |
| Carbon Monoxide | ASTM D1946 | Analysis of Reformed Gas by Gas Chromatography (GC) with Thermal Conductivity Detection (TCD) |
| Aromatic Phenols (gaseous vapor) | EPA TO-8 | Phenols and Cresols in Ambient Air by High Pressure Liquid Chromatography HPLC |
| Hydrocarbons ($C_5$ to $C_{10}$) | EPA TO-14 | Volatile Organic Compounds in Ambient Air by GC/FID (flame ionization detection) |
| Hydrocarbons ($C_2$ to $C_4$) | EPA TO-14 | Volatile Organic Compounds in Ambient Air by GC/FID |

## V. CLAIM OF CATEGORICAL EXCLUSION FROM THE ENVIRONMENT ASSESSMENT

Hawaii International Seafood claims a categorical exclusion from the environmental assessment **(EA)** and environmental impact statements (EIS). Under the recently finalized environmental impact consideration regulations, actions involving "the approval of food additive, color additive, or GRAS petitions for substances added directly to food that are intended to remain in food through ingestion by consumers and that are not intended to replace macronutrients in the food," ordinarily do not require the preparation of an **EA** or **EIS.** 26/

**FDA** clarified in the preamble to the proposed rule that "[e]xamples of the types of additives and GRAS substances that belong to this class are the color additives added to foods listed in **21 CFR** parts **73** and **74,** most of the direct food additives listed in part **172 (21** CFR parts **172)**, and certain GRAS substances listed in part **184 (21** CFR part **184.).** 27/ FDA further offered that "examples of substances not included in this class for which this categorical exclusion is being proposed are the substances intended to replace macronutrients in food (such as sweetening agents intended to replace sugar *e.g.*, see §§ **172.800** and **172.804,** and fat substitutes *e.g.*, **184.1498.**" 28/

---

26/ **62** ***Fed. Reg.*** **40570, 40595 (1997)** (to be codified at **21** CFR **§ 25.32(k) (1998)).**

271 **61** ***Fed. Reg.*** **19476, 19482 (1996)** ***(emphasis added).***

28/ *Id.*

Although the GRAS premarket notification proposed rule would not require an environmental assessment, the GRAS affirmation petition regulations do require one. Because the agency has not yet issued the final rule that would establish the GRAS premarket notification procedures, Hawaii International Seafood submits a request for a categorical exclusion.

This GRAS premarket notification complies with the categorical exclusion criteria in 21 CFR § 25.32(k) (1998). Tasteless smoke is a direct food ingredient that is intended to remain in the food through ingestion, and it is not a macronutrient. In addition, to the knowledge of Hawaii International Seafood, there are no extraordinary circumstances that would refute this categorical exclusion.

# Appendix 1

# Tasteless Smoke and Raw Smoke Analytical Reports

000043

[redacted]

INALAB, INC.

# INALAB, INC.

3615 HARDING AVE. • SUITE 308 • HONOLULU. HAWAII 96816
(808) 735-0422 • FAX (808) 735-0047

TECHNICAL EXPERTS CONSULTING IN
ENVIRONMENTAL • FORENSIC • OCCUPATIONAL AND LABORATORY SERVICES

## Laboratory Brief

Hawaii International Seafood, Inc.
Honolulu International Airport
P.O. Box 30486
Honolulu, Hawaii 96820
Phone (808) 839-5010
Fax (808) 833-0712

Date: April 18, 1997

Attention: Mr. William Kowalski

Date sample submilled: April 10, 1997 at 1215 hours
Date sample analyzed: April 10, 1997
Inalab Number: 97041008

Analysis of an air sample for permanent / organic gas content via Gas Chromatography.

| Component | Amount (%) |
|---|---|
| **Permanent Gases** | |
| Oxygen | 17.7 |
| Nitrogen | Balance |
| Carbon Monoxide | 8.0 |
| Carbon Dioxide | 0.8 |
| Methane | 1.5 |
| Other Gases ($H_2O$, hydrocarbons, etc.) | <1% |
| Total hydrocarbons as methane | <0.1% (~750ppm v/v) |

*EPA Accredited AHERA Inspectors/Management Planners • NIST Technical Experts in Bulk Asbestos Identification*
*Ph.D. Chemists, Environmental Scientists, Toxicologists and ABIH Certified Industrial Hygienists*

ANALYTICAL REPORT

ENVIRONMENTAL
Analytical Service. Inc.

# Tasteless Smoke

## ASTM 1945 PERMANENT GAS BY GC/TCD

Client: Hawaii Internatinal Seafood
Sample ID: 7FS7-71209SRF
Can No.: T-bag

EAS No: 70394-7
Sampled: NA
Analyzed: 9/19/97

| Componenl | MDL ppmv | MDL % | Sample Concentration ppmv | % | %* |
|---|---|---|---|---|---|
| Hydrogen | 200 | 0.020 | 11972 | 1.20 | 1.20 |
| Oxygen + Argon | 50 | 0.005 | 171230 | 17.12 | 17.18 |
| Argon | 50 | 0.005 | NA | NA | NA |
| Nitrogen | 50 | 0.005 | 617829 | 61.78 | 61.98 |
| Melhane | 50 | 0.005 | 32159 | 3.22 | 3.23 |
| Carbon Monoxide | 50 | 0.005 | 84930 | 8.49 | 8.52 |
| Carbon Oioxide | 50 | 0.005 | 78771 | 7.88 | 7.90 |
| TOTAL | | | | 99.7 | 100.0 |

Argon co-elutes with Oxygen
Atmospheric Argon is 0.946%
* Indicates sample conc. is normalized to 100%
ND - not delected at a concentration above the MDL
NA - not measured, because analysis not requested

ANALYTICAL REPORT

Raw Smoke

ENVIRONMENTAL
Analytical Service. Inc.

ASTM 1945 PERMANENT GAS BY GC/TCD

Client: Hawaii Internatinal Seafood
Sample ID: 12 COMBO
Can No.: T-bag

EAS No: 70394-12
Sampled: NA
Analyzed: 9/19/97

| Componenl | MOL ppmv | MOL % | Sample Concentralion ppmv | % | %* |
|---|---|---|---|---|---|
| Hydrogen | 200 | 0.020 | 33909 | 3.39 | 3.49 |
| Oxygen + Argon | 50 | 0.005 | 114599 | 11.46 | 11.78 |
| Argon | 50 | 0.005 | NA | NA | NA |
| Nitrogen | 50 | 0.005 | 412358 | 41.24 | 42.39 |
| Melhane | 50 | 0,005 | 98985 | 9.90 | 10.18 |
| Carbon Monoxide | 50 | 0.005 | 200655 | 20.07 | 20.63 |
| Carbon Dioxide | 50 | 0.005 | 112203 | 11.22 | 11.54 |

Argon co-elules with Oxygen
Atmospheric Argon is 0.946% TOTAL 97.3 100.0
* Indicates sample conc. is normalized lo 100%
NO - not defected at a concentration above the MDL
NA - not measured, because analysis not requesled

**ANALYTICAL REPORT**

ENVIRONMENTAL
Analytical Service, Inc

e

**ASTM 1945 PERMANENT GAS BY GC/TCD**

| | | | |
|---|---|---|---|
| Client: | Hawaii International Seafood | EAS No: | 70493-1 |
| Sample ID: | Sample Cylinder | | |
| Can No.: | Yellow Cylinder | Sampled: | 10/29/97 |
| | | Analyzed: | 11/7/97 |

| Component | MDL ppmv | MDL % | Sample Concentration ppmv | % | %* |
|---|---|---|---|---|---|
| Hydrogen | 200 | 0.020 | 55432, | 5.54 | 5.87 |
| Oxygen + Argon | 50 | 0.005 | 46242 | 4.62 | 4.90 |
| Argon | 50 | 0.005 | NA | NA | NA |
| Nitrogen | 50 | 0,005 | 194569 | 19.46 | 20.62 |
| Methane | 50 | 0.005 | 137749 | 13.77 | 14.60 |
| Carbon Monoxide | 50 | 0.005 | 275762 | 27.58 | 29.22 |
| Carbon Dioxide | 50 | 0.005 | 233995 | 23.40 | 24.79 |
| | | | TOTAL | 94.4 | 100.0 |

Argon co-elutes with Oxygen
Atmospheric Argon is 0.946%
* indicates sample conc. is normalized to 100%
ND - not detected at a concentration above the MDL
NA - not measured, because analysis not requested

# ANALYTICAL REPORT

TPH by EPA-18 GC/FID

Laboratory Number: 70493-1

File: 7049301C.D

Client: HAWAII INTERNATIONAL SEAFOOD

Description: SAMPLE CYLINDER

Can#: NA

Date Sampled: 10/29/97

Date Analyzed: 11/7/97

Analyst: YL

Code: PA

| Compound | MDL ppmV | Concentration ppmV | Concentration mg/m3 |
|---|---|---|---|
| TPH as Hexane | 80.000 | 7489.170 | 27255.771 |

# Analytical Report

ENVIRONMENTAL

Analytical Service, Inc

## Phenols by EPA TO-8

Page 1 of 1

| | | | |
|---|---|---|---|
| Client: | Hawaii International Seafood | Date Sampled: | NA |
| Project: | Smoke Analysis | Date Analyzed: | 12/4/97 |
| Matrix: | Phenol | Analysed by: | SDH |

Daily QA/QC

| | Sample Result ug/ml | Spike Added ug/ml | Spike Result ug/ml | Recovery % | RPD % |
|---|---|---|---|---|---|
| Method Blank | ND | NA | NA | ---- | N/A |
| Matrix Spike | NA | NA | NA | NA | NA |
| Matrix Spike Dup. | NA | | | NA | NA |

| EAS ID | Client Description | MDL ug | Result ug | Data Flag | ug/L |
|---|---|---|---|---|---|
| 70493-1 | Yellow Cylinder Imp #1 | 0.1 | 5.75 | | 5.75 |
| 70493-2 | Yellow Cylinder Imp#2 | 0.1 | ND | | ND |
| TOTAL | | | | | 5.75 |

Notes: 1) MDL = Minimum Detection Limit, ug/ml in 50 ml of extract
2) ND = Not Detected

7049301.HPL

# Appendix 2

# Chemical Composition of Wood Smoke

EXHIBIT E

CHEMICAL COMPOSITION OF WOOD SMOKE

| Species 1 | g/kg wood 2 | Physical State 3 | Reference |
|---|---|---|---|
| Water Vapor | 35-105 | V | 2 |
| Carbon Dioxide | 70-200 | V | 2 |
| Carbon Monoxide | 80-370 | V | 4,5 |
| Methane | 14-25 | V | 5 |
| VOCS (C2-C&) | 7-27 | V | 5 |
| Aldehydes | 0.6-5.4 | V | 4,6 |
| Formaldehyde | 0.1-0.7 | V | 4,6 |
| Acrolein | 0.02-01 | V | 6 |
| Propionaldehyde | 0.1-0.3 | V | 4,6 |
| Butryafdehyde | 0.01-1.7 | V | 4,6 |
| Acetaldehyde | 0.03-0.6 | V | 4,6 |
| Furfural | 0.2-1.6 | V | 7,8 |
| Substituted Furans | 0.15-1.7 | V | 5 |
| Benzene | 0.6-4.0 | V | 9 |
| Alkyl Benzenes | 1-6 | V | 9 |
| Toluene | 0.15-1.0 | V | 7 |
| Acetic Acid | 1.8-2.4 | V | 7 |
| Formic Acid | 0.06-0.08 | V | 4,5 |
| Nitrogen Oxides (NO, N02) | 0.2-0.9 | V | 4 |
| Sulfur Dioxide | 0.16-0.24 | V | 10 |
| Methyl chloride | 0.0-0.04 | V | 9 |
| Napthalene | 0.24-1.6 | V | 9 |
| Substituted Napthalenes | 0.3-2.1 | V/P | 9 |
| Oygenated Monoaromatics | 1-7 | V/P | 11 |
| Guaiacols | 0.4-1.6 | V/P | 11 |
| Phenols | 0.2-0.8 | V/P | 11 |
| Syringols | 0.7-2.7 | V/P | 11 |
| Catechols | 0.2-0.8 | V/P | 5 |
| Total Particulate Mass | 7-30 | P | 12 |
| Oxygenated PAHs | 0.15-1.0 | V/P | 13 |
| PAHs | | | |
| Fluorene | 0.00004-0.017 | V/P | 13 |
| Phenanthrene | 0.00002-0.034 | V/P | 13 |
| Anthracene | 0.00005-0.021 | V/P | 13 |
| Methylan-tbracenes | 0.00007-0.008 | V/P | 13 |
| Fluoranthene | 0.0007-0.042 | V/P | 13 |

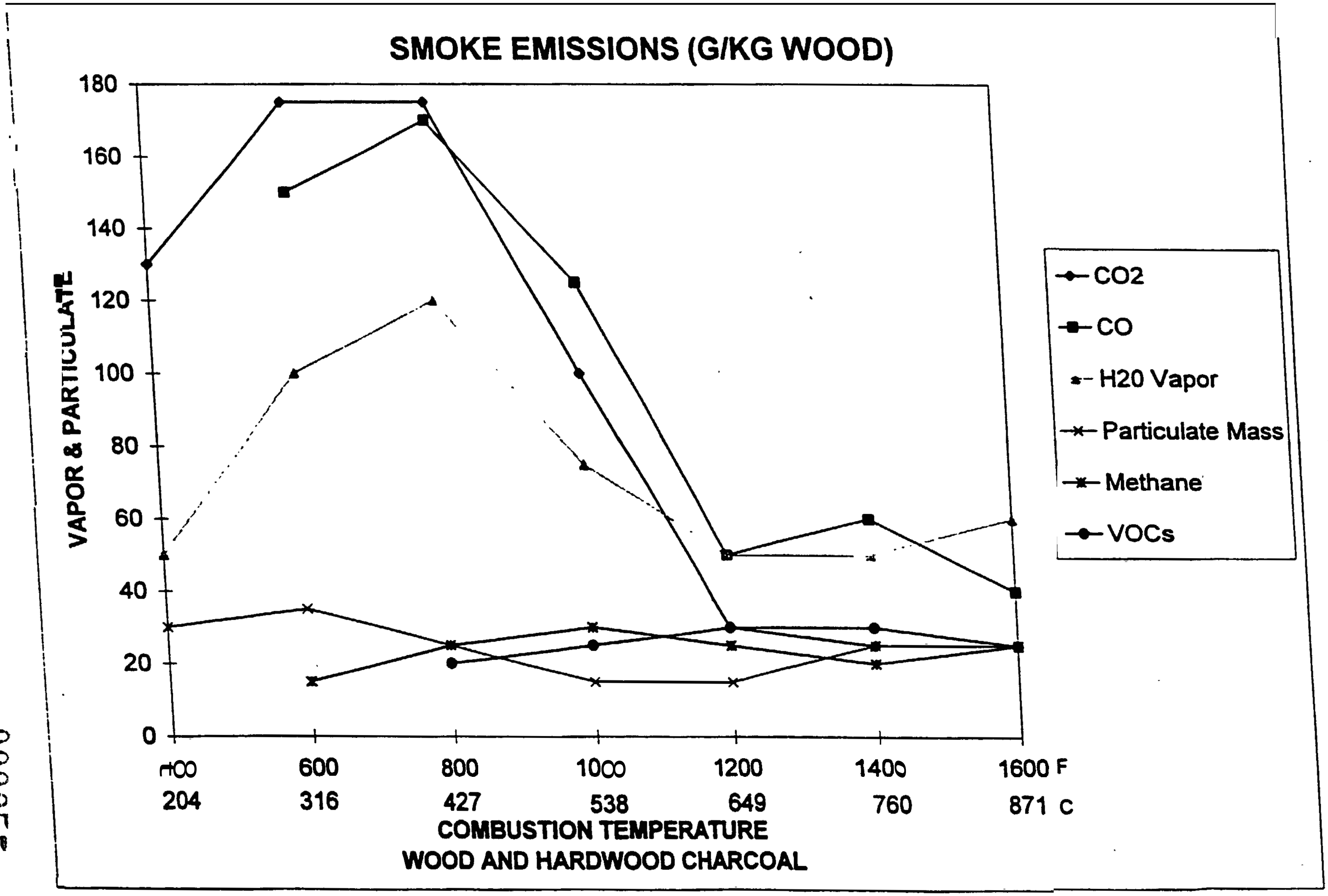
| | | | |
|---|---|---|---|
| Pyrene | 0.0008-0.031 | V/P | 13 |
| Benzo(a) anthracene | 0,0004-0.002 | V/P | 13 |
| Chrysene | 0.0005-0.01 | V/P | 13 |
| Benzo-fluranthenes | 0.0006-0.005 | V/P | 13 |
| Benzo(e)pyrene | 0.0002-0.004 | V/P | 13 |
| Benzo(a)pyrene | 0.0003-0.005 | V/P | 13 |
| Perylene | 0.00005-0.003 | V/P | 13 |
| Ideno(1,2, 3-cd)pyrene | 0.0002-0.013 | V/P | 13 |
| Benz(ghi) perylene | 0.00005-0.011 | V/P | 13 |
| Coronene | 0.0008-0.003 | V/P | 13 |
| Dibenzo(a,h) pyrene | 0.0003-0.001 | V/P | 13 |
| Retene | 0.007-0.03 | V/P | 14 |
| Dibenz(a,h) anthracene | 0.00002-0.002 | V/P | 13 |
| Trace Elements | | | |
| Na | 0.003-0.018 | P | 15 |
| Mg | 0.0002-0.003 | P | 15 |
| Al | 0.0001-0.024 | P | 15 |
| Si | 0.0003-0.031 | P | 15 |
| S | 0.001-0.029 | P | 15 |
| Cl | 0.0007-0.21 | P | 15 |
| K | 0.003-0.086 | P | 15 |
| Ca | 0.0009-0.018 | P | 15 |
| Ti | 0.00004-0.003 | P | 15 |
| V | 0.00002-0.004 | P | 15 |
| Cr | 0.00002-0.003 | P | 15 |
| Mn | 0.00007-0.004 | P | 15 |
| Fe | 0.0003-0.005 | P | 15 |
| Ni | 0.000001-0.001 | P | 15 |
| Cu | 0.0002-0.0009 | P | 15 |
| Zn | 0.00007-0.004 | P | 15 |
| Br | 0.00007-0.0009 | P | 15 |
| Pb | 0.0001-0.003 | P | 15 |
| Particulate Elemental Carbon | 0.3-5 | P | 16 |
| Normal Alkanes (C24-C30) | 0.001-0.006 | P | 17 |
| Cyclic di- and triterpenoids | | | |
| Dehydroabietic | | | |

| | | | |
|---|---|---|---|
| acid | 0.001-0.006 | P | 18 |
| Isopimaric acid | 0.02-0.10 | P | 18 |
| Lupenone | 0.002-0.008 | P | 18 |
| Friedelin | 0.000004-0.00002 | P | 18 |
| Chlorinated dioxins | 0.0000-0.00004 | P | 19 |
| Particulate Acidity | 0.007-0.07 | P | 20 |

1. Some species are grouped into general classes as indicated by italics.
2. To estimate the weight percentage in the exhaust, divide the g/kg value by 80. This assumes that there are 7.3 kg combustion air per kg of wood. Carbon dioxide and water vapor average 12 and 7 weight percent respectively.
3. At ambient conditions: V= vapor, P = particulate, and V/P = vapor and/or particulate (i.e., semi-volatile).
4. DeAngelis (1980).
5. OMNI (1988)
6. Lipari (1984), values for fireplaces
7. Edye et al (1991), smoldering conditions; other substituted furans include 2-furanmenthanol, 2 acetylfuran, 5-methyl-2furaldehyde, and benzofuran.
8. Value estimated for pine from Edye et al (1991,) from reported yield relative to guaiacol, from guaiacol values of Hawthorne (1989) and assuming particulate organic carbon is 50% of total particle mass.
9. Steiber et al (1992), values computed assuming a range of 3-20 g of total extractable, speciated mass per kg wood.
10. Khalil (1983)
11. Hawthorne (1989), values for syringol or hardwood fuel; see also Hawthorne (1988)
12. Core (1989), DeAngelis (1980), Kalman and Larson (1987)
13. From one or more of the following studies: Cooke (1981), Truesdale (1984), Alfheim et al (1984), Zeedijk (1986), Core (1989), Kalman and Larson (1987); assuming a range of 7 to 30 grams particulate mass per kg wood when values were reported in grams per gram of particulate mass. Similar assumptions apply to references 14, 15, and references 17-19.
14. Core (1989), Kalman and Larson (1987)
15. Watson (1979), Core (1989, Kalman and Larson (1987)
16. Rau (1989), Core (1989)
17. Core (1989)
18. Standley and Simoneit (1990); Dehydroabietic acid values for pine smoke, lupenone and isopimaric acid values for alder smoke, and friedelin values for *oak* soot.
19. Nestrick and Lamparski (1982), from particulate condensed on flue pipes; includes TCDDs, HCDDs, H7CDDs and OCDDs.
20. Burnet et al (1986); one gram of acid = one equivalent of acid needed to reach *a* pH of *5.6* in extract solution.

# Appendix 3

# Composition of Wood Smoke Emission at Varying Combustion Temperatures


SMOKE EMISSIONS (G/KG WOOD)
VAPOR & PARTICULATE
180
160
140
120
100
80
60
40
20
0
400
600
800
1000
1200
1400
1600 F
204
316
427
538
649
760
871 C
COMBUSTION TEMPERATURE
WOOD AND HARDWOOD CHARCOAL
CO2
CO
H20 Vapor
Particulate Mass
Methane
VOCs

# Appendix 4

## Typical Wood Fuel Chemical Analysis

EXHIBIT D

TYPICAL WOOD FUEL CHEMICAL ANALYSIS

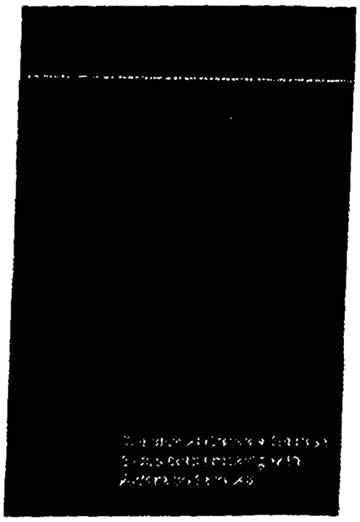
| Analysis (dry basis), % by wt | Oak Chips | Spruce Chips |
|---|---|---|
| Proximate | | |
| Volatile matter | 76.0 | 69.5 |
| Fixed carbon | 18.7 | 26.6 |
| Ash | 5.3 | 3.8 |
| Ultimate | | |
| Hydrogen | 5.4 | 5.7 |
| Carbon | 49.7 | 51.8 |
| Sulfur | 0.1 | 0.1 |
| Nitrogen | 0.2 | 0.2 |
| Oxygen | 39.3 | 38.4 |
| Ash | 5.3 | 3.8 |
| Heating value, Btu/lb | 8,370 | 8,740 |
| Ash Analysis % by wt | | |
| $SiO_2$ | 11.1 | 32.0 |
| $Fe_2O_3$ | 3.3 | 6.4 |
| $TiO_2$ | 0.1 | 0.6 |
| $Al_2O_3$ | 0.1 | 11.0 |
| $Mn_3O_4$ | Trace | 1.5 |
| CaO | 64.5 | 25.3 |
| MgO | 1.2 | 4.1 |
| $Na_2O$ | 8.0 | 8.0 |
| $K_2O$ | 0.2 | 2.4 |
| $SO_3$ | 2.0 | 2.1 |
| Cl | Trace | Trace |

Source: "Wood residue - fired steam generator particulate matter control technology assessment, U.S. E.P.A., 1978.

# Appendix 5

## Testimonials Establishing Pre-1958 Use of Filtered Cold Smoke to Preserve Seafood

Show Order | Josephson's Smokehouse & Specialty Seafood | Info | Request Catalog



## *Cold Smoked Chinook Salmon*

**Slowly** smoked with **natural** smoke from alderwood **is** the key **to** the rich flavor **of Grandpa** Anton's **Traditional Smoked Salmon. Salmon** fillets are ***cured*** **and** then **hung** in our two old-fashioned gravity smokehouses. After a short drying time **the slow** cold **smoking** proce **begins.** The flavorful alderwood smoke continuously generated in **the** smokehouse drifts up **past** the salmon sides **and out** the smoke-stack. The resulting smoked salmon **has *a*** delecta smokey flavor **and firm** texture **that is** sure to please **your** family and friends.

Scandinavian-style Smoked Salmon open-faced sandwiches served **on *a* dark *rye,*** preferabl Swedish or molasses **rye, spread** with **cream** cheese are **a** traditional **Scandinavian** delicacy **family** gatherings, **weddings and** other festive **occasions** these finger sandwiches are alway and are often the **first** item **to** disappear from the buffet. The buttery rich flavor **and cold** s texture **of our** lightly cured Smoked Salmon Lox is delicious **on** bagels with cream cheese. fillets are smoked **on** racks in **our two** modern horizontal air-flow smokehouses **until** they r savory perfection.

**Traditional Style Cold Smoked Chinook Salmon**

**Lox Stvle Cold Smoked Salmon Side**

**Lox on Gold**

000059

000059

Show Order Josephson's Smokehouse & Specialty Seafood Info Request Catalog

## Lox Style Cold Smoked Salmon Side

lox lox lox lox lox cold smoked salmon cold smoked salmon cold smoked s cold smoked salmon cold smoked salmon

Josephson's most delicate process. Highest quality farm-raised salm lightly salted and smoothly smoked with alderwood to produce a won flavor and naturally buttery textured lox. If breakfast at home on Sunday is incomplete without lox and bagels or l scrambled eggs, then our individually vacuum packed Chinook Lox sides will enable you to keep a suppty on-han satisfy your craving. Simply freeze upon arrival and use as needed. Vacuum-sealed sliced lox packages keep 3 t weeks under refrigeration. Once opened use within 7 days.

Quantities below are in pounds. For example, a 3 lb side sells for $88, a 4 lb side sells for $117. You may also ch have your Lox sliced by us, but please remember that this will add $3 per pound to your order when processed.

Must be shipped by 2nd Day Air or Next Day Air.

4801S Three Pounds: $88.00, 4/$117.00, 5/$145.00 Order

Show Order Josephson's Smokehouse & Specialty Seafood Info Request Catalog

## Traditional Style Cold Smoked Chinook Salmon

**traditional cold smoked chinook salmon traditional cold smoked chinook s traditional cold smoked chinook salmon traditional cold smoked chinook s traditional cold smoked chinook salmon**

Josephson's famous **77** year-old family Scandinavian process. High quality Pacific Chinook Salmon are dry salted and **slowly** smoked wit alderwood *to* produce **a** rich smoky flavor and firm texture similar **to** Since **1920** Grandpa Anton's Traditional Smoked Salmon has found regulars over the years. **For** them this has been the "perfect present" gift that is right for the friend who has everything, the relative **who** is please, **or** the business associate you want **to** impress. More **so** toda ever before, food has become the universally appealing gift - one that can be repeated annually without misgivin after year our customers have enjoyed giving and receiving our Traditional Smoked Salmon,

Refrigerate **6 weeks/freeze 6** months. Quantities below are in pounds. **For** example, **1** lb sells for **$29, 2** lbs sell fo **You** may ***also*** choose to have your Traditional sliced **by** us, but please remember that this **will** add $3 per pound t **order** when processed.

**Must** be shipped by 2nd Day **Air or** Next Day Air.

21510S One pound = **$29.00, 2/$57.00, 3/$84.00, 5/$129.00** Slicing: Unsliced Ord

# SPORTSMEN'S CANNERY & SMOKEHOUSE

*Naturally Northwest*

That's the best way we can describe the natural, **pure** product in our Seafood. We include no preservatives, water, or oil in the gourmet canned **fish** we offer. The clean, clear Pacific waters provide us at **Sportsmen's Cannery & Smokehouse** with *only* the freshest top-quality **fish** for **our** cans. You, **as** the customer, are getting the best that money can buy.

**The Sportsmen's Cannery & Smokehouse** was established *in* 1955 **and has** been **run** continuously as **a** family business. We have stayed in business because **of** the quality of our products **and** the enthusiasm **of our** customers. We can **for sport** fishermen and **for our** customers. All of our seafood products are **troll** caught, hand-packed and canned fresh from the ocean. ***Our*** smoked seafood **is** specially brinned **and** alder smoked without chemical additives **or coloring.** Besides being delicious **and** ready to eat right out ***of* the** can, seafood is low in calories **and high** in vitamins **and** protein as well as being a natural source **of** calcium **and 0-MEGA 3** (essential fatty acids).

Click **Here** to **See Our** Selection **of** THE **Finest** Canned **Seafoods In** The World **!**

**Click Here** To **See Our List** of **Special Gift Packages Combining an Assortment of Sportsman's** Cannery & **Smokehouse** Delicacies **from** the **Sea.**

Call us at **(800) 457-8048** **SPORTSMAN'SCANNERY &** 000062

SINCE 1921 Lascco BRAND

December 18, 1997

Jeanne W. Evans
HAWAII INTERNATIONAL SEAFOOD, INC.
P.O. Box 30486
Honolulu, HI 96820

TO WHOM IT MAY CONCERN:

This letter is to verify that LOS ANGELES SMOKING & CURING COMPANY (LASCCO) has been processing smoked and pickled fish since 1921.

LASCCO processes and markets a complete line of products nationally and is the largest processor in the western United States.

Should you require additional information, please feel free to contact me.

Sincerely,

Richard D. Schaffer
Vice President of Sales & Marketing

RS:lcp



778 KOHLER STREET, LOS ANGELES, CA 90021
SALES & MARKETING: TEL (213) 628.1246 FAX (213) 614.8857
ACCOUNTING & ADMINISTRATION: TEL (213) 629.0724 FAX (213) 624.2369

# Appendix 6

# Expert Testimonials that Tasteless Smoke is GRAS

Colorado State University

Department of Food Science
and Human Nutrition
Fort Collins, Colorado 80523-1571
(970) 491-6535
FAX: (970) 491-7252

January 15, 1998

Mr. William Kowalski
Hawaii International Seafoods, Inc.
P.O. Box 30486
Honolulu, Hawaii 96820

Dear Mr. Kowalski:

I was scheduled to bs out of the country for two weeks, but I returned • few days early and found several pieces of correspondence from you. I hope you get this response in time to incorporate into your report.

Color measurement was performed using a Hunter lab color difference meter. The spelling you forwarded is correct.

Objective quantitative texture measurements were performed using an Allo-Kramer shear press (not sheet press). Uniform cores of flesh (1/2 inch in diameter) were placed on the cutting surface of the instrument and the samples were cut with the machine knife. The amount of force, in pounds per square inch, required to cut through the sample was automatically recorded. Three separate measurements were taken on each sample and the values obtained were averaged and reported to you.

GRAS opinion:

Based on my knowledge relative to smoke generation and use, and upon reading in detail your process for obtaining tasteless smoke, it is my professional opinion that your tasteless smoke product can/should be considered to be GRAS. It basically is a natural sub-fraction of liquid smoke which is currently a GRAS ingredient.

However, the GRAS approach and the use of CO m y be in conflict under current regulations.

If you have any more last minute questions, you can call me during local time office hours (8-5) or please feel free to call me at home if I m not in the office(970 226-1544)

Sincerely,

Joseph A. Maga, Ph.D.

ENVIRONMENTAL
Analytical Service, Inc.

**FAX TRANSMISSION**

| | | | |
|---|---|---|---|
| Attention | Bill Kowalski | | |
| Company | Hawaii International Seafood | | |
| Location | Honolulu | CA | |
| FAX | 808-833-0712 | Phone | 808-839-5010 |
| Fax Sent By | Steve Hoyt | Total Pages | 1 |

**MESSAGE**

Dear Bill,

1/13/98

I would say that the tasteless smoke has less considerably lower concentrations of chemical compounds in it than the regular smoke sample. This would including the amounts of particulates, volatile organics, phenols, and Carbon Monoxide. For this reason I would consider the tasteless smoke to be generally recognized as a safe ingredient (GRAS).

Sincerely,
Steven D. Hoyt, Ph.D.

# Appendix 7

# Texture Measurement Results

# Texture Measurements
# Two Month Frozen and Defrosted

### Raw Texture

| Sample # | Untreated | Tasteless Smoke |
|---|---|---|
| 22 | 7.2 | 6.8 |
| 41 | 6.7 | 6.5 |
| 57 | 6.7 | 6.6 |
| 87 | 6.5 | 6.1 |
| 109 | 7.0 | 6.8 |
| 207 | 6.8 | 6.5 |
| 221 | 7.4 | 7.0 |
| 227 | 7.0 | 6.5 |
| Averages | 6.91 | 6.60 |

### Cooked Texture

| Sample # | Untreated | Tasteless Smoke |
|---|---|---|
| 22 | 7.5 | 7.0 |
| 41 | 7.0 | 6.8 |
| 57 | 7.3 | 6.9 |
| 87 | 6.9 | 6.7 |
| 109 | 7.4 | 7.1 |
| 207 | 7.3 | 7.0 |
| 221 | 7.5 | 7.4 |
| 221 | 7.3 | 6.9 |
| Averages | 7.23 | 6.98 |



\\\DC - 66887/1 - 0588075 01

## Texture Measurements
## Two Month Frozen and Defrosted

### Raw Texture

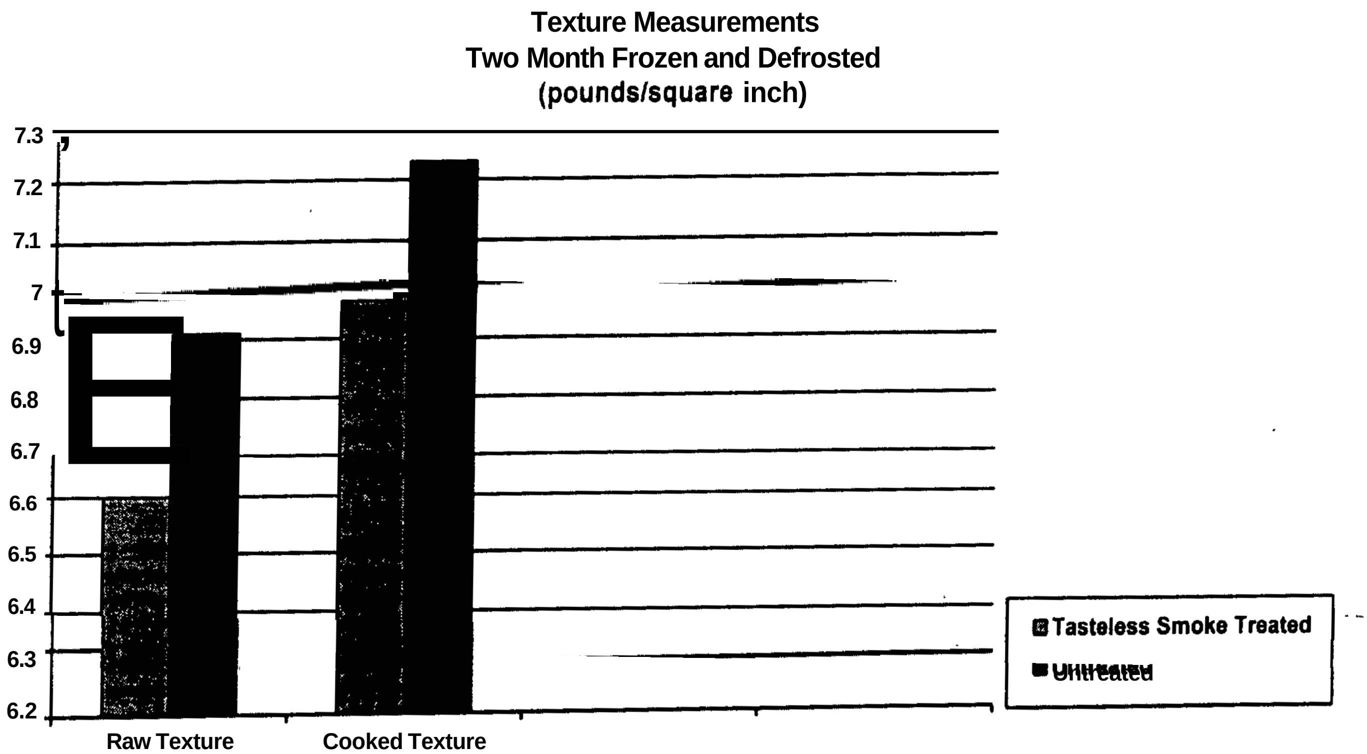
| Sample # | Raw Smoke | Tasteless Smoke |
|---|---|---|
| 136 | 6.5 | 6.4 |
| 65 | 6.0 | 6.1 |
| 158 | 6.6 | 6.5 |
| Averages | 6.37 | 6.33 |

### Cooked Texture

| Sample # | Raw Smoke | Tasteless Smoke |
|---|---|---|
| 136 | 6.7 | 6.5 |
| 65 | 6.3 | 6.5 |
| 158 | 6.8 | 6.7 |
| Averages | 6.60 | 6.57 |



\\\DC - 66887/1 - 0588079 01




000070

\\DC - 66887/1 - 0588072 01

# Texture Measurements
# Six Month Frozen and Defrosted

### Raw Texture

| Sample # | Untreated | Tasteless Smoke |
|---|---|---|
| 8 | 6.50 | 6.30 |
| 9 | 6.30 | 6.00 |
| 10 | 6.60 | 6.30 |
| 12 | 6.70 | 6.50 |
| Averages | 6.53 | 6.28 |

### Cooked Texture

| Sample # | Untreated | Tasteless Smoke |
|---|---|---|
| 8 | 6.70 | 6.60 |
| 9 | 6.70 | 6.30 |
| 10 | 7.10 | 6.90 |
| 12 | 7.10 | 6.70 |
| Averages | 6.90 | 6.63 |



\\\DC - 66887/1 - 0588096 01

# Appendix 8

# Aroma Intensity Raw Data

## Aroma Intensity Evaluations
## Two Month Frozen and Defrosted

### Raw Aroma Intensity

| Sample # | CO Treated | Untreated | Tasteless Smoke |
|---|---|---|---|
| 22 | 4 | 6 | 5 |
| 41 | 5 | 6 | 5 |
| 57 | 6 | 7 | 6 |
| 87 | 5 | 5 | 5 |
| 109 | 4 | 5 | 4 |
| 207 | 6 | 7 | 6 |
| 221 | 5 | 6 | 6 |
| 227 | 5 | 6 | 5 |
| **Averages** | **5.00** | **6.00** | **5.25** |

### Cooked Aroma Intensity

| Sample # | CO Treated | Untreated | Tasteless Smoke |
|---|---|---|---|
| 22 | 5 | 7 | 6 |
| 41 | 6 | 6 | 6 |
| 57 | 7 | 8 | 7 |
| 87 | 6 | 6 | 5 |
| 109 | 5 | 6 | 5 |
| 207 | 7 | 8 | 7 |
| 221 | 6 | 7 | 7 |
| 227 | 6 | 7 | 6 |
| **Averages** | **6.00** | **6.88** | **6.13** |

# Aroma Intensity Evaluations
# Two Month Frozen and Defrosted

### Raw Aroma Intensity

| Sample # | Raw Smoke | Tasteless Smoke |
|---|---|---|
| 136 | 5 | 5 |
| 65 | 6 | 5 |
| 158 | 5 | 6 |
| Averages | 5.33 | 5.33 |

### Cooked Aroma Intensity

| Sample # | Raw Smoke | Tasteless Smoke |
|---|---|---|
| 136 | 6 | 6 |
| 65 | 7 | 6 |
| 158 | 6 | 7 |
| Averages | 6.33 | 6.33 |



\\\DC - 66887/1 - 0588032 01

## Aroma Intensity Evaluations
## *Six* Month Frozen and Defrosted

### Raw Aroma Intensity

| Sample # | CO Treated | Untreated | Tasteless Smoke |
|---|---|---|---|
| 8 | 5 | 7 | 6 |
| 9 | 8 | 8 | 7 |
| 10 | 6 | 7 | 6 |
| 12 | 7 | 8 | 6 |
| Averages | 6.50 | 7.50 | 6.25 |

### Cooked Aroma Intensity

| Sample # | CO Treated | Untreated | Tasteless Smoke |
|---|---|---|---|
| 8 | 8 | 9 | 7 |
| 9 | 9 | 9 | 8 |
| 10 | 7 | 9 | 7 |
| 12 | 7 | 9 | 7 |
| Averages | 7.75 | 9.00 | 7.25 |



\\\DC - 66887/1 - 0588093 01

# Appendix 9

# pH Measurements Test

## pH Measurements
## Two Month Frozen and Defrosted

| Sample # | Untreated | Tasteless Smoke |
|---|---|---|
| 22 | 5.94 | 5.91 |
| 41 | 5.88 | 5.88 |
| 57 | 6.28 | 6.26 |
| 87 | 5.81 | 5.79 |
| 109 | 5.96 | 5.92 |
| 207 | 5.90 | 5.87 |
| 221 | 5.99 | 5.97 |
| 5.93 | 5.99 | 5.99 |
| Averages | 5.97 | 5.95 |

| Sample # | Raw Smoke Treated | Tasteless Smoke |
|---|---|---|
| 136 | 6.03 | 5.99 |
| 158 | 6.41 | 6.33 |
| 158 | 5.87 | 5.85 |
| Averages | 6.10 | 6.06 |

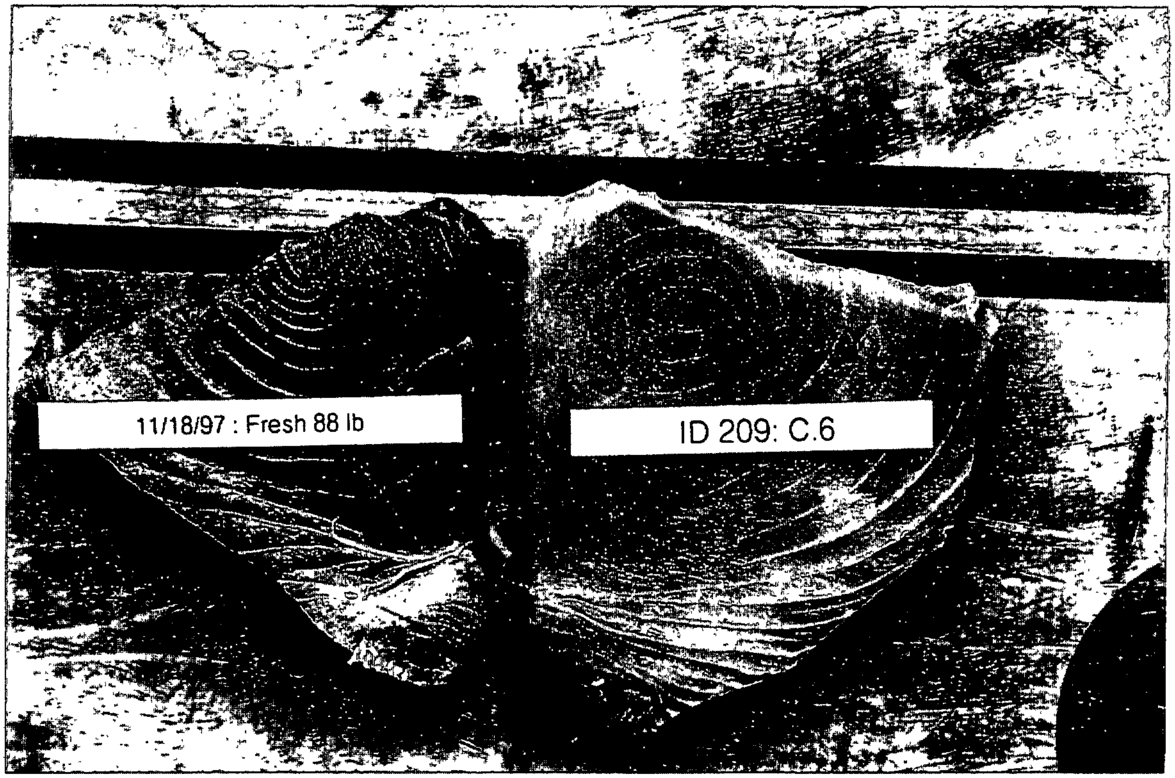
# Appendix 10

## Untouched Color Photographs



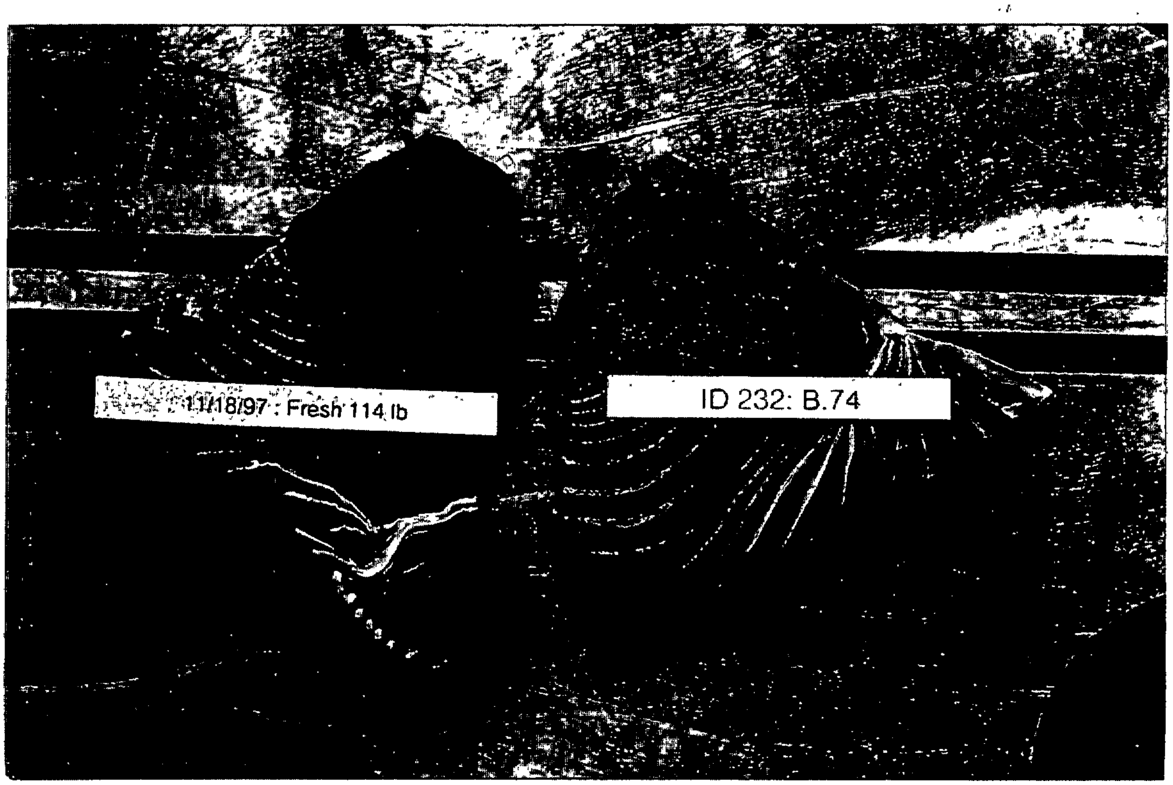
\\\DC - 66887/1 - 0622276 01

PHOTOGRAPH 1

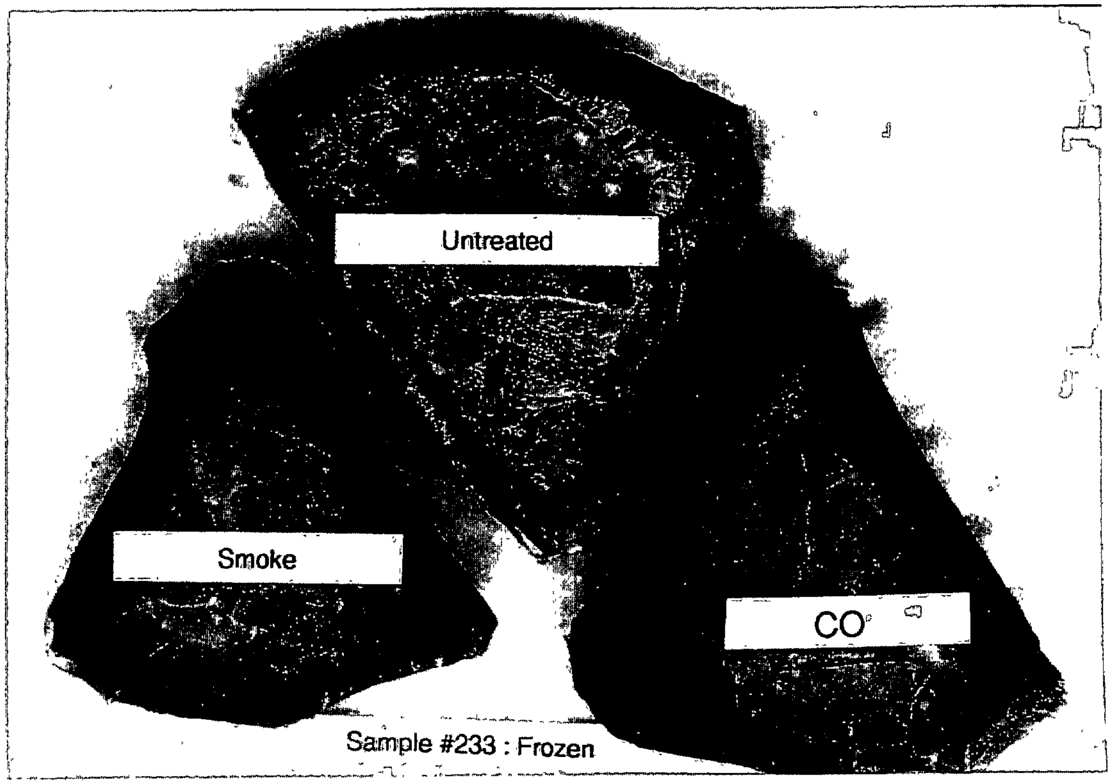



000079

PHOTOGRAPH 2

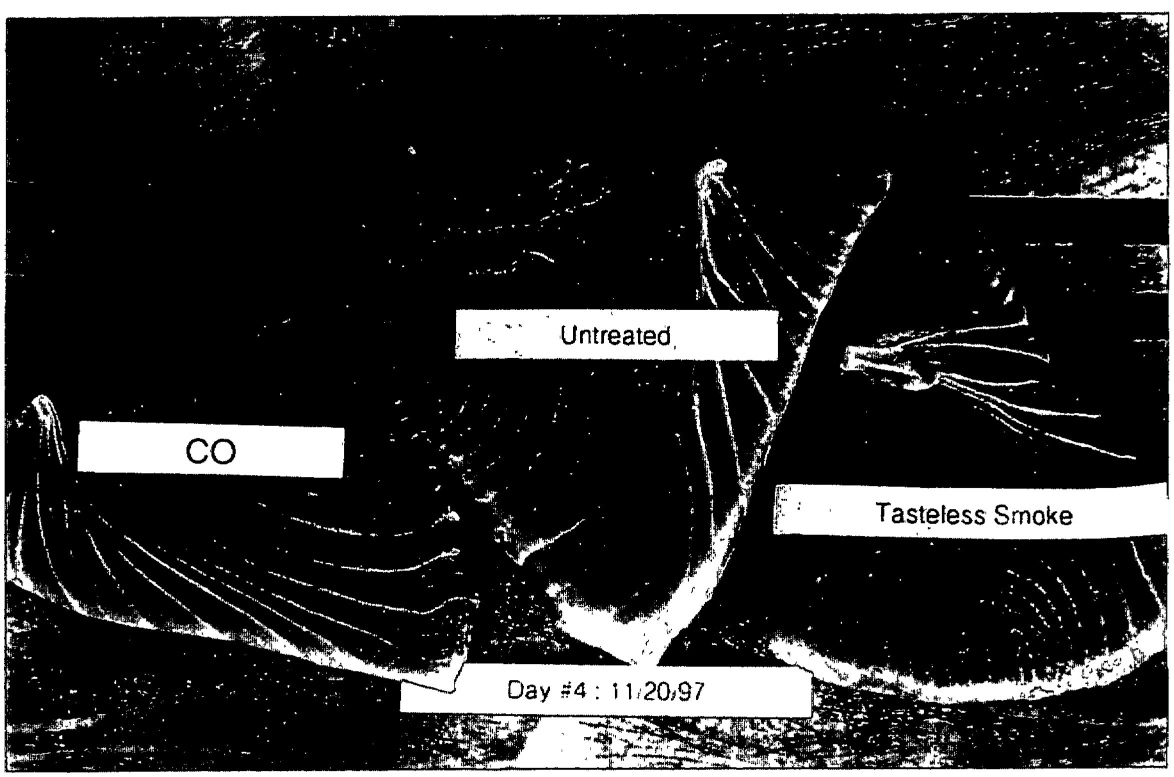


PHOTOGRAPH - 3




000080

PHOTOGRAPH - 4



# Appendix 11

# Data of Color Properties Test Results
# (Tuna and Salmon)

## Color Properties - Day One
## Fresh Tuna

| Sample | Light | Red | Yellow |
|---|---|---|---|
| **Bigeye - 81.2kg** | | | |
| 179 | 80.7 | +2.1 | +0.7 |
| **Yellowfin - 58.5kg** | | | |
| 129 | 80.3 | +1.9 | +0.6 |
| **Bigeye - 37.6kg** | | | |
| 83 | 80.3 | +1.8 | +0.5 |
| **Yellowfin - 36.2kg** | | | |
| 92 | 79.9 | +1.1 | +0.2 |
| **Yellowfin - 39.4kg** | | | |
| 87 | 80.1 | +1.9 | +0.5 |
| **Averages** | **80.26** | **+1.76** | **+0.50** |

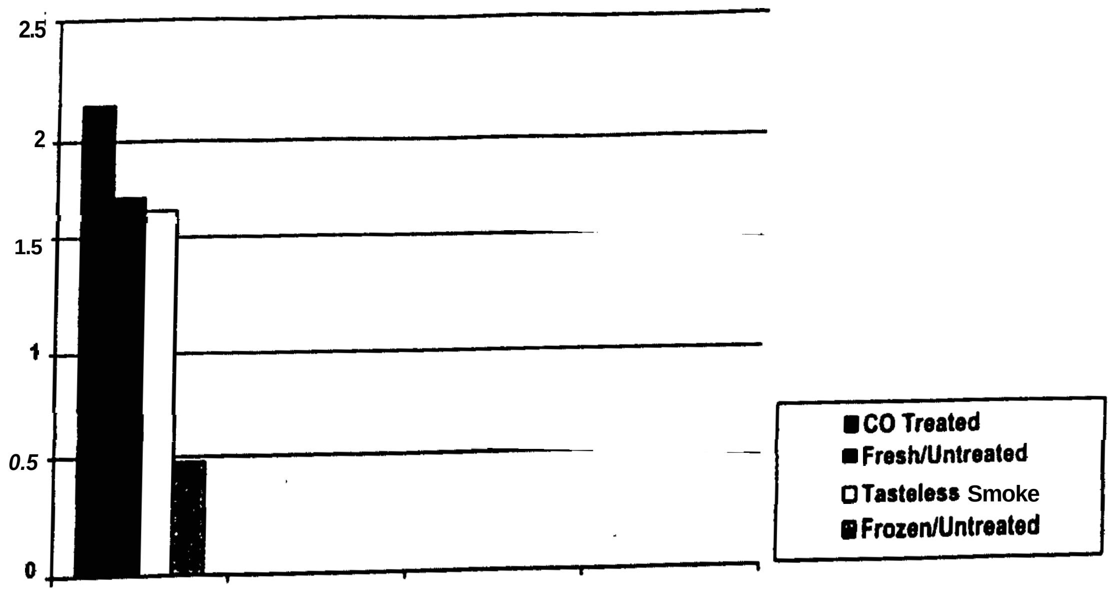
# Tuna Color Properties - Day One
## Two Month Frozen Defrosted

| | CO Treated | | | Untreated | | | Tasteless Smoke | | |
|---|---|---|---|---|---|---|---|---|---|
| Sample | Light | Red | Yellow | Light | Red | Yellow | Light | Red | Yellow |
| **Bigeye 46kg - Japan "B" Grade** | | | | | | | | | |
| 19 | 81.10 | +2.90 | +1.10 | 80.70 | +1.00 | +0.80 | 80.90 | +2.00 | +0.90 |
| 20 | 80.60 | +3.00 | +0.90 | 80.10 | +0.80 | +0.60 | 80.20 | +1 90 | +0.50 |
| 21 | 80.90 | +3.40 | +1.20 | 80.70 | +1.00 | +1.10 | 80.70 | +2.20 | +1.00 |
| 22 | 81.00 | +3.50 | +1.30 | 80.50 | +1.00 | +0.60 | 80.60 | +2.40 | +0.90 |
| 23 | 81.20 | +3.10 | +1.40 | 81.20 | +0.80 | +1.20 | 81.40 | +2.40 | [illegible] |
| 24 | 82.10 | +3.20 | +1.50 | 81.80 | +0.80 | +1.30 | 81.20 | +2.30 | +1.10 |
| Averages | 81.10 | +3.18 | +1.23 | 80.30 | +0.90 | +0.90 | 80.30 | +2.20 | +1.01 |
| **Yellowfin 38kg - #1 Cooking Grade** | | | | | | | | | |
| 39 | 80.80 | +2.30 | +1.10 | 81.10 | +0.60 | +1.20 | 81.00 | +1.90 | +1.20 |
| 40 | 81.00 | +2.10 | +1.20 | 80.80 | +1.00 | +1.20 | 80.70 | +1.80 | +1.10 |
| 41 | 81.60 | +2.30 | +1.20 | 80.80 | +0.80 | +1.30 | 80.80 | +1.60 | +1.20 |
| 42 | 60.90 | +2.00 | +1.10 | 80.40 | +0.50 | +0.80 | 80.10 | +1.20 | +0.70 |
| 50 | 80.30 | +1 90 | +0.70 | 80.20 | +0.50 | +0.80 | 80.20 | +1.00 | +0.60 |
| 51 | 80.40 | +1.60 | +0.70 | 80.40 | +0.10 | +0 70 | 80.50 | +0.10 | +0.70 |
| 52 | 80.20 | +1.60 | +0.60 | 80.40 | +0.30 | +0.60 | 80.00 | +0.80 | +0.40 |
| 53 | 80.70 | +1.90 | +1.00 | 80.30 | +0.50 | +0.80 | 80.20 | +1.10 | +6.00 |
| Averages | 80.70 | +1.96 | +0.96 | 80.55 | +0.53 | +0.92 | 80.40 | +1.18 | +1.46 |
| **Yellowfin 28kg - #1 Cooking Grade** | | | | | | | | | |
| 83 | 81.70 | +1.30 | +0.80 | 81.20 | +0.00 | +0.50 | 80.20 | +1.50 | +0.70 |
| 84 | 80.70 | +2.00 | +1.20 | 80.50 | +0.10 | +1.00 | 80.50 | +1.60 | +1.00 |
| 85 | 80.80 | +2.80 | +1.20 | 80.40 | +0.40 | +0.80 | 80.00 | +2.00 | +0.90 |
| 86 | 80.30 | +1.60 | +0.80 | 80.10 | +0.10 | +0.50 | 80.80 | +1.70 | +0.70 |
| 87 | 81.40 | +1.50 | +0.50 | 82.20 | +0.20 | +0.30 | 81.30 | +1.10 | +0.50 |
| Averages | 80.90 | +1.84 | +0.90 | 80.80 | +0.16 | +0.62 | 80.60 | +1.58 | +0.76 |
| **Yellowfin 41kg - #1 Cooking Grade** | | | | | | | | | |
| 192 | 80.20 | +2.40 | +0.70 | 80.00 | +0.60 | +0.50 | 80.30 | +1.90 | +0.80 |
| 193 | 80.40 | +2.60 | +1.10 | 80.40 | +0.60 | +0.80 | 80.20 | +2.20 | +0.90 |
| 194 | 80.10 | +2.20 | +0.60 | 80.20 | +0.90 | +0.80 | 80.50 | +2.50 | +0.90 |
| 195 | 80.20 | +1.60 | +0.90 | 80.10 | +0.20 | +0.80 | 80.00 | +1.60 | +0.90 |
| 205 | 80.20 | +2.40 | +0.60 | 80.00 | +0.60 | +0.40 | 80.50 | +2.30 | +0.70 |
| 208 | 80.40 | +2.30 | +1.00 | 80.30 | +0.30 | +0.90 | 80.70 | +2.10 | +1.30 |
| 207 | 80.10 | +1.90 | +0.70 | 79.60 | +0.00 | +0.30 | 80.00 | +1.80 | +0.70 |
| Averages | 80.20 | +2.20 | +0.80 | 80.10 | +0.45 | +0.64 | 80.30 | +2.05 | +0.88 |
| **Yellowfin 44kg - #1 Cooking Grade** | | | | | | | | | |
| 217 | 80.80 | +1.90 | +0.80 | 80.50 | +0.60 | +0.80 | 80.60 | +1.60 | +0.60 |
| 218 | 81.00 | +1.90 | +1.10 | 81.00 | +0.50 | +1.00 | 81.00 | +1.90 | +1.30 |
| 219 | 80.80 | +1.60 | +0.80 | 80.80 | +0.30 | +0.90 | 80.50 | +1.60 | +0.60 |
| 220 | 81.30 | +1.90 | +1.10 | 81.00 | +0.30 | +1.00 | 80.30 | +1.30 | +0.90 |
| 221 | 80.60 | +1.60 | +0.80 | 80.00 | +0.00 | +0.40 | 80.00 | +1.50 | +0.50 |
| 227 | 80.70 | +1.10 | +0.70 | 80.70 | +0.60 | +0.90 | 80.70 | +2.10 | +1.00 |
| 230 | 80.60 | +1.80 | +1.00 | 80.00 | +0.00 | +0.60 | 80.30 | +1.00 | +0.70 |
| Averages | 80.82 | +1.68 | +0.90 | 80.67 | +0.32 | +0.80 | 80.49 | +1.67 | +0.80 |

## Tuna Color Properties- Day One
## Six Month Frozen and Defrosted

| | CO Treated | | | Untreated | | | Tasteless Smoke | | |
|---|---|---|---|---|---|---|---|---|---|
| Sample# | Light | Red | Yellow | Light | Red | Yellow | Light | Red | Yellow |
| 8 | 82.80 | +1.50 | +0.50 | 82.70 | +1.70 | +0.40 | 82.20 | +0.90 | +0.60 |
| 9 | 83.40 | +1.80 | +0.40 | 83.50 | +1.90 | +0.30 | 83.00 | +1.10 | +0.50 |
| 10 | 83.60 | +2.40 | +0.70 | 83.10 | +1.00 | +0.50 | 83.40 | +2.40 | +0.70 |
| 12 | 83.20 | +2.40 | +0.60 | 87.90 | +0.90 | +0.40 | 83.10 | +2.40 | +0.60 |
| Averages | 81.26 | +2.03 | +0.55 | 84.30 | +1.38 | +0.74 | 82.93 | +1.70 | +0.60 |

Red Color Values • Day One
Yellowfin and Bigeye Tuna






000085

## Tuna Color Properties - Day five
## Two Month Frozen and Defrosted

| | CO Treated | | | Untreated | | | Tasteless Smoke | | |
|---|---|---|---|---|---|---|---|---|---|
| Sample | Light | Red | Yellow | Light | Red | Yelllow | Light | Red | Yellow |
| **Bigeye** 46kg - Japan "B" Grade | | | | | | | | | |
| 19 | 81.40 | +2.70 | +1.00 | 81.30 | +0.70 | +0.50 | 81.10 | +1.80 | +0.70 |
| 20 | 80.80 | +2.80 | +0.80 | 80.50 | +0.50 | +0.30 | 80.40 | +1.70 | +0.40 |
| 21 | 81.00 | +3.20 | +1.00 | 81.10 | +0.70 | +0.80 | 80.90 | +2.00 | +0.80 |
| 22 | 81.20 | +3 30 | +1.10 | 80.90 | +0.60 | +0.30 | 80 80 | +2.20 | +0.70 |
| 23 | 81.30 | +3 00 | +1.30 | 81.50 | +0.50 | +0.90 | 81.60 | +2.60 | +1.60 |
| 24 | 82.30 | +3.00 | +1.40 | 82.10 | +0.50 | +1.00 | 81.40 | +2.10 | +1.10 |
| Averages | 81.33 | +3.00 | +1.10 | 81.23 | +0.58 | +0.63 | 81.03 | +2.06 | +0.88 |
| Yellowfin 38kg - #1 Cooking Grade | | | | | | | | | |
| 39 | 81.00 | +2.20 | +1.10 | 81.50 | +0.30 | +0.90 | 81.20 | +1.70 | +1.00 |
| 40 | 81.10 | +2.00 | +1.00 | 81.30 | +0.50 | +0.90 | 80.90 | +1.60 | +0.90 |
| 41 | 81.70 | +2.20 | +1.10 | 81.30 | +0.50 | +1.00 | 81.00 | +1.40 | +1.00 |
| 42 | 81.10 | +1.90 | +1.00 | 80.80 | +0.20 | +0 50 | 80.30 | +1.00 | +0.50 |
| 50 | 80.40 | +1.70 | +0.60 | 80.60 | +0.20 | +0.50 | 80.40 | +0.80 | +0.40 |
| 51 | 80.50 | +1.50 | +0.60 | 80.90 | +0.30 | +0.20 | 80.70 | +0.00 | +0.50 |
| 52 | 80.40 | +1.50 | +0.50 | 81.80 | +0.40 | +0.30 | 80.30 | +0.60 | +0.20 |
| 53 | 80.80 | +1.70 | +0.90 | 80.90 | +0.20 | +0.40 | 80.40 | +0.90 | +0.40 |
| **Averages** | 80.67 | +1.83 | +0.85 | 81.01 | +0.32 | +0.58 | 80.65 | +1.00 | +0.61 |
| **Yellowfin** 28kg - #1 Cooking Grade | | | | | | | | | |
| 83 | 81.60 | +1 20 | +0.70 | 81.60 | +0.40 | +0.10 | 80.50 | +1.20 | +0.50 |
| 84 | 80.80 | +1.80 | +0.70 | 80.90 | +0.40 | +0.40 | 80.70 | +1.40 | +0.80 |
| 85 | 80.90 | +2 70 | +1.10 | 80.90 | +0.00 | +0.30 | 80.80 | +1.70 | +0.70 |
| 86 | 80.50 | +1.50 | +0.70 | 80.60 | +0.20 | +0.20 | 81.00 | +1.50 | +0.50 |
| 87 | 81.50 | +1.40 | +0.40 | 82.60 | +0.30 | +0.00 | 81.50 | +0.90 | +0.30 |
| Averages | 81.06 | +1.72 | +0.72 | 81.32 | +0.26 | +0.20 | 80.90 | +1.34 | +0.56 |
| Yellowfin 41 kg - #1 Cooking Grade | | | | | | | | | |
| 192 | 80.40 | +2.10 | +0.50 | 80.50 | +0.20 | +0.10 | 80.50 | +1.70 | +0.60 |
| 193 | 80.50 | +2.50 | +1.00 | 80.90 | +0.20 | +0.30 | 80.50 | +2.00 | +0.70 |
| 194 | 80.20 | +2.50 | +1.10 | 80.90 | +0.10 | +0.20 | 80.40 | +2.00 | +0.60 |
| 195 | 80.20 | +2.00 | +0.50 | 80.70 | +0.40 | +0.20 | 80.70 | +2.10 | +0.70 |
| 205 | 80.30 | +1.50 | +0.70 | 80.70 | +0.00 | +0.40 | 80.20 | +1.40 | +0.70 |
| 206 | 80.40 | +2.30 | +0.50 | 80.70 | +0.20 | +0.00 | 80.70 | +2.00 | +0.50 |
| 207 | 80.20 | +1.80 | +0.60 | 80.50 | +0.20 | +0.00 | 80.20 | +1.60 | +0.50 |
| **Averages** | 00.30 | +2.10 | +0.70 | 80.70 | +0.18 | +0.17 | 00.46 | +1.82 | +0.61 |
| **Yellowfin 44kg - #1** Cooking Grade | | | | | | | | | |
| 217 | 80.90 | +1.80 | +0.70 | 81.00 | +0.10 | +0.20 | 80.80 | +1.40 | +0.40 |
| 218 | 81.10 | +1.80 | +1.00 | 81.50 | +0.10 | +0.60 | 81.20 | +1.70 | +1.10 |
| 219 | 80.90 | +1.50 | +0.70 | 81.20 | +0.60 | +0.50 | 80.70 | +1.40 | +0.40 |
| 220 | 81.50 | +1.80 | +1.00 | 81.50 | +0.00 | +0.50 | 80.50 | +1.10 | +0.70 |
| 221 | 80.70 | +1.50 | +0.70 | 80.50 | +0.30 | +0.00 | 80.20 | +1.20 | +0.30 |
| 227 | 80.80 | +1.00 | +0.60 | 81.20 | +0.20 | +0.50 | 60.90 | +2.00 | +0.80 |
| 230 | 80.80 | +1.70 | +0.90 | 80.50 | +0.30 | +0.20 | 80.50 | +0.80 | +0.50 |
| Average8 | 80.96 | +1.58 | +0.80 | 81.06 | +0.22 | +0.35 | 80.68 | +1.37 | +0.60 |

Color Properties • Day One
Two Month Frozen and Defrosted

# Yellowfin and Bigeye Tuna

## Light/Darkness Color Values

| | CO | Untreated | Tasteless |
|---|---|---|---|
| High | 82.10 | 82.20 | 81.40 |
| Low | 80.10 | 79.60 | 80.00 |
| Average | 80.74 | 80.55 | 80.49 |

## Red Color Values

| | CO | Untreated | Tasteless |
|---|---|---|---|
| High | +3.50 | +1.00 | +2.40 |
| Low | +1.30 | +0.00 | +0.10 |
| Averages | +2.15 | +0.48 | +1.70 |

## Yellow Color Values

| | CO | Untreated | Tasteless |
|---|---|---|---|
| High | +1.50 | +1.30 | +1.50 |
| Low | +0.50 | +0.30 | +0.40 |
| Averages | +0.95 | +0.79 | +0.85 |

Color properties - Day Five
Two Month Frozen and Defrosted

# Yellowfin and Bigeye Tuna

## Light/Darkness Color Values

| | CO | Untreated | Tasteless |
|---|---|---|---|
| High | 82.30 | 82.60 | 81.60 |
| Low | 80.20 | 80.50 | 80.20 |
| Averages | 80.88 | 81.10 | 80.72 |

## Red Color Values

| | CO | Untreated | Tasteless |
|---|---|---|---|
| High | +3.30 | +0.70 | +2.60 |
| Low | +1.00 | +0.00 | +0.00 |
| Averages | +2.00 | +0.31 | +1.47 |

## Yellow Color Values

| | CO | Untreated | Tasteless |
|---|---|---|---|
| High | +1.40 | +1.00 | +1.60 |
| Low | +0.40 | +0.00 | +0.20 |
| Averages | +0.83 | +0.38 | +0.50 |

## Albacore Color Properties - Day One
## Two Month Frozen and Defrosted

| | CO Treated | | | Untreated | | | Tasteless Smoke | | |
|---|---|---|---|---|---|---|---|---|---|
| Sample | Light | Red | Yellow | Light | Red | Yellow | Light | Red | Yellow |
| Albacore 31kg - #1 Cooking Grade | | | | | | | | | |
| 105 | 80.70 | +1 40 | +0.80 | 81.30 | +0.40 | +1.10 | 81.10 | +1.30 | +0.90 |
| 106 | 81.00 | +1.80 | +0.90 | 81.70 | +0.30 | +0.90 | 81.50 | +1.80 | +1.40 |
| 107 | 81.20 | +1.40 | +1.10 | 81.30 | +0.20 | +1.10 | 81.00 | +1.50 | +1.10 |
| 108 | 82.50 | +2.40 | +1.30 | 82.00 | +0.70 | +1.10 | 82.40 | +1.40 | +1.20 |
| 109 | 81.80 | +1.50 | +1.40 | 82.60 | +0.50 | +1.90 | 81.80 | +1.30 | +1.30 |
| 110 | 81 70 | +1 90 | +1.20 | 82.20 | +1.40 | +1.30 | 81.50 | +1.80 | +1.20 |
| Averages | 81.40 | +1.73 | +1.11 | 81.60 | +0.58 | +1.23 | 61.50 | +1.51 | +1.18 |

## Albacore Color Properties - Day Five
## Two Month Frozen and Defrosted

| | CO Treated | | | Untreated | | | Tasteless Smoke Treated | | |
|---|---|---|---|---|---|---|---|---|---|
| Sample | Light | *Red* | Yellow | Light | *Red* | Yellow | Light | *Red* | Yellow |
| Albacore 31kg - #1 Cooking Grade | | | | | | | | | |
| 105 | 80.90 | +1.30 | +0.70 | 81.60 | +0.10 | +0.70 | 81.40 | +1.00 | +0.70 |
| 106 | 81.10 | +1.70 | +0.70 | 81.20 | +0.00 | +0.50 | 81.70 | +1.60 | +1.20 |
| 107 | 81.40 | +1.30 | +1.00 | 81.70 | +0.20 | +0.70 | 81.20 | +1.30 | +0.80 |
| 108 | 82.60 | +2.20 | +1.20 | 82.50 | +0.20 | +0.80 | 82.60 | +1.20 | +1.00 |
| 109 | 81.90 | +1.40 | +1.30 | 83.00 | +0.11 | +1.40 | 82.00 | +1.00 | +1.10 |
| 110 | 81.80 | +1.80 | +1.10 | 82.70 | +1.00 | +0.80 | 81.70 | +1.60 | +1.00 |
| Averages | 81.61 | +1.61 | +1.00 | 82.11 | +0.26 | +0.81 | 81.76 | +1.28 | +0.96 |

**Color Properties - Day One**
**Two Month Frozen and Defrosted**

# Albacore Tuna

## Light/Darkness Color Values

| | CO | Untreated | Tasteless |
|---|---|---|---|
| High | 82.50 | 82.60 | 82.40 |
| Low | 80.70 | 80.70 | 81.00 |
| Averages | 81.40 | 81.60 | 81.50 |

## Red Color Values

| | CO | Untreated | Tasteless |
|---|---|---|---|
| High | +2.40 | +1.40 | +1.80 |
| Low | +1.40 | +0.20 | +1.30 |
| Averages | +1.73 | +0.58 | +1.51 |

## Yellow Color Values

| | CO | Untreated | Tasteless |
|---|---|---|---|
| High | +1.40 | +1.90 | +1.40 |
| Low | +0.80 | +0.90 | +0.90 |
| Averages | +1.11 | +1.23 | +1.18 |

Color Properties - Day Five
Two Month Frozen and Defrosted

# Albacore Tuna

## Light/Darkness Color Values

| | CO | Untreated | Tasteless |
|---|---|---|---|
| High | 82.60 | 83.00 | 82.60 |
| Low | 80.90 | 81.20 | 81.20 |
| Averages | 81.60 | 82.11 | 81.76 |

## Red Color Values

| | CO | Untreated | Tasteless |
|---|---|---|---|
| High | +2.20 | +1.00 | +1.60 |
| Low | +1.30 | +0.00 | +1.00 |
| Averages | +1.61 | +0.26 | +1.28 |

## Yellow Color Values

| | CO | Untreated | Tasteless |
|---|---|---|---|
| High | +1.30 | +1.40 | +1.20 |
| Low | +0.70 | +0.50 | +0.70 |
| Averages | +1.00 | +0.81 | M.96 |

**Salmon *Color* Properties - Day One**
**Two Month Frozen and *Defrosted***

| | CO Treated | | | Untreated | | | Tasteless Smoke | | |
|---|---|---|---|---|---|---|---|---|---|
| Sample | Light | Red | Yellow | Light | Red | Yellow | Light | Red | Yellow |
| Salmon 3.1 kg - Japan "B" Grade | | | | | | | | | |
| 56 | 81.60 | +4.40 | +2.70 | 81.30 | +3.20 | +2.30 | 81.40 | +4.00 | +2.60 |
| 57 | 81.60 | +4.30 | +2.60 | 81.10 | +3.10 | +2.30 | 81.70 | +3.50 | +2.40 |
| Averages | 81.60 | +4.35 | +2.65 | 81.20 | +3.15 | +2.30 | 81.66 | +3.75 | +2.50 |

## Salmon Color Properties - Day Five
## Two Month Frozen and Defrosted

| | CO Treated | | | Untreated | | | Tasteless Smoke | | |
|---|---|---|---|---|---|---|---|---|---|
| Sample | Light | Red | Yellow | Light | Red | Yellow | Light | Red | Yellow |
| Salmon 3.1kg - Japan "B" Grade. | | | | | | | | | |
| 56 | 81.80 | +4.20 | +2.60 | 81.50 | +2.80 | +2.60 | 81.60 | +3.80 | +2.40 |
| 57 | 81.70 | +4 20 | +2.50 | 81.50 | +2.70 | +2.00 | 81.90 | +3.30 | +2.20 |
| Averages | 81.75 | +4.20 | +2.55 | 81.6 | +2.75 | +2.30 | 81.76 | +3.55 | +2.30 |

Color Properties - Day One
Two Month Frozen and Defrosted

# SALMON

## Light/Darkness Color Values

| | CO | Untreated | Tasteless |
|---|---|---|---|
| High | 81.60 | 81.30 | 81.70 |
| Low | 81.60 | 81.10 | 81.40 |
| Averages | 81.60 | 81.20 | 81.55 |

## Red Color Values

| | CO | Untreated | Tasteless |
|---|---|---|---|
| High | +4.40 | +3.20 | +4.00 |
| Low | +4.30 | +3.10 | +3.50 |
| Averages | +4.35 | +3.15 | +3.75 |

## Yellow Color Values

| | CO | Untreated | Tasteless |
|---|---|---|---|
| High | +2.70 | +2.30 | +2.60 |
| Low | +2.60 | +2.30 | +2.40 |
| Averages | +2.65 | +2.30 | +2.50 |

## Color Properties - Day Five
## Two Month Frozen and Defrosted

# SALMON

### Light/Darkness Color Values

| | CO | Untreated | Tasteless |
|---|---|---|---|
| High | 81.80 | 81.50 | 81.90 |
| Low | 81.70 | 81.50 | 81.60 |
| *Averages* | 81.75 | 81.50 | 81.75 |

### Red Color Values

| | CO | Untreated | Tasteless |
|---|---|---|---|
| High | +4.20 | +2.80 | +3.80 |
| Low | +4.20 | +2.70 | +3.30 |
| *Averages* | +4.20 | +2.75 | +3.55 |

### Yellow Color Values

| | CO | Untreated | Tasteless |
|---|---|---|---|
| High | +2.60 | +2.60 | +2.40 |
| Low | +2.50 | +2.00 | +2.20 |
| Averages | +2.55 | +2.30 | +2.30 |

# Appendix 12

# Data Demonstrating that Tasteless Smoke and Conventional Smoke have Comparable Effects on Tuna, Salmon and Albacore

## Raw Smoke vs. Tasteless Smoke Color Properties - Day One
## Two Month Frozen and Defrosted

# TUNA

Light/Darkness

| | Raw Smoke | Tasteless |
|---|---|---|
| High | 82.60 | 82.70 |
| Low | 82.00 | 81.70 |
| Average | 82.20 | 82.10 |

Red

| | Raw Smoke | Tasteless |
|---|---|---|
| High | +3.90 | +3.50 |
| Low | +2.90 | +2.90 |
| Average | +3.40 | +3.10 |

Yellow

| | Raw Smoke | Tasteless |
|---|---|---|
| High | +2.10 | +1.90 |
| Low | +1.40 | +1.60 |
| Average | +1.77 | +1.72 |

# SALMON

Light/Darkness

| | Raw Smoke | Tasteless |
|---|---|---|
| High | 82.20 | 81.50 |
| Low | 81.80 | 81.50 |
| Average | 82.00 | 81.50 |

Red

| | Raw Smoke | Tasteless |
|---|---|---|
| High | +3.90 | +3.60 |
| Low | +3.20 | +2.90 |
| Average | +3.55 | +3.25 |

Yellow

| | Raw Smoke | Tasteless |
|---|---|---|
| High | +2.60 | +2.70 |
| Low | +2.20 | +2.70 |
| Average | +2.40 | +2.70 |

# ALBACORE

Light/Darkness

| | Raw Smoke | Tasteless |
|---|---|---|
| High | 82.90 | 82.90 |
| Low | 81.40 | 81.50 |
| Average | 82.00 | 82.00 |

Red

| | Raw Smoke | Tasteless |
|---|---|---|
| High | +2.70 | +2.70 |
| Low | +2.10 | +1.40 |
| Average | +2.30 | +1.84 |

Yellow

| | Raw Smoke | Tasteless |
|---|---|---|
| High | +1.70 | +1.80 |
| Low | +1.10 | +1.20 |
| Average | +1.38 | +1.43 |

## Tasteless Smoke vs. Raw Smoke Color Properties - Day Five
## Two Month Frozen and Defrosted

# TUNA

Light/Darkness

| | Raw Smoke | Tasteless |
|---|---|---|
| High | 82.80 | 83.00 |
| Low | 82.30 | 81.90 |
| Average | 82.52 | 82.35 |

Red

| | Raw Smoke | Tasteless |
|---|---|---|
| High | +3.60 | +3.30 |
| Low | +2.80 | +2.60 |
| Average | +3.15 | +2.82 |

Yellow

| | Raw Smoke | Tasteless |
|---|---|---|
| High | +2.00 | +1.60 |
| Low | +1.10 | +1.40 |
| Average | +1.57 | +1.47 |

# SALMON

Light/Darkness

| | Raw Smoke | Tasteless |
|---|---|---|
| High | 82.40 | 81.60 |
| Low | 82.30 | 81.60 |
| Average | 82.00 | 81.60 |

Red

| | Raw Smoke | Tasteless |
|---|---|---|
| High | +3.50 | +4.20 |
| Low | +3.00 | +2.80 |
| Average | +3.25 | +3.25 |

Yellow

| | Raw Smoke | Tasteless |
|---|---|---|
| High | +2.50 | +2.50 |
| Low | +2.40 | +2.10 |
| Average | +2.45 | +2.40 |

# ALBACORE

Light/Darkness

| | Raw Smoke | Tasteless |
|---|---|---|
| High | 83.00 | 83.00 |
| Low | 81.70 | 81.70 |
| Average | 82.20 | 82.23 |

Red

| | Raw Smoke | Tasteless |
|---|---|---|
| High | +2.50 | +2.60 |
| Low | +1.90 | +1 20 |
| Average | +2.15 | +1.95 |

Yellow

| | Raw Smoke | Tasteless |
|---|---|---|
| High | +I .40 | +1.70 |
| Low | +0.90 | +I .00 |
| Average | +1.18 | +1.26 |



\\\DC - 66887/1 - 0588082 01

# Appendix 13

## Panel Results Demonstrating Tasteless Smoke Treated Tuna Has Properties Different From CO Treated Tuna

# SEAFOOD SAMPLE ANALYSIS

Date 9.12.97 Technician Name/names S. FISHER, N. NUKWATNI

Sample Procedure Informaton:

Sample lot # CYI 001 Species ALBACORE Production code NA

Sample Code CO Test Applied 18 HR CO TREAT - FROZEN

Sample Code UNT Test Applied CONTROL - FROZEN

Sample Code SMOKE Test Applied 18 HR SMK TREAT - FROZEN (TASTELESS FILTERED SMK)

| Fresh ___ Fzn Thawed X # Days Fresh ___ # Days Thawed 1 Sample Code. AB | COLOR A. Red/pink natural. B. Slightly faded red/pink. C. Bright unnatural red-pink. D. Brown, grey or colorless. | RAW TASTE A. Natural fish taste. B. Flat, little or no tatse C. Slightly off, fishy or "freezer" taste. D. Very fishy, very off. | COOKED TASTE A. Natural fish taste. B. Flat, little or no taste C. Slightly fishy or "freezer" taste. D. Very fishy, very off | TEXTURE A. Firm, resilient. B. Slightly soft, dimples when pressed. C. Md. soft/ seperation. D. Mushy, broken. | DE-COMP A. Pleasant natural fish smell. B. Slightly fishy or sulpher smell. C. Fishy/sulphterous D. Spoiled | COMMENT (SEE PHOTOS) |
|---|---|---|---|---|---|---|
| CO | C | B | B | A | A | |
| UNT | D | C | C | B | A | |
| SMOKE | A | A | A | B | A | |
| | | | | | | |
| 9-14 DAY 3: | | | | | | |
| CO | C | NA | B | B | B* | *NOT SAME "CHEMICAL" SMELL |
| UNT | D | NA | C | C | B | |
| SMOKE | B | NA | C | C | B | |
| | | | | | | |
| | | | | | | |

# SEAFOOD SAMPLE ANALYSIS

Date 9.12.97 Technician Name/names S. FISHER , N. NOCWATNI

Sample Procedure Information:

Sample lot # CV1002 Species YELLOWFIN Production code NA

Sample Code YFN Test Applied 18-24 HR SMOKE - FROZEN (TASTELESS FILTERED SMOKE)

Sample Code YFCO Test Applied 18-24 HR CO - FROZEN

Sample Code X Test Applied X - NA

| Fresh ___<br>FA Thawed Y<br># Days Fresh ___<br># Days Thawed 1<br>Sample Code YF | COLOR<br>A. Red/pink natural<br>B. Slightly faded red/pink.<br>C. Bright unnatural red-pink.<br>D. Brown, grey or colorless | RAW TASTE<br>A. Natural fish taste.<br>B. Flat, little or no taste.<br>C. Slightly off, fishy or "freezer" taste.<br>D. Very fishy, very off. | COOKED TASTE<br>A. Natural fish taste<br>B. Flat, little or no taste<br>C. Slightly fishy or "freezer" taste.<br>D. Very fishy, very off. | TEXTURE<br>A. Firm, resilient<br>B. Slightly soft, dimples when pressed<br>C. Md soft/ seperation<br>D. Mushy, broken. | DE-COMP<br>A. Pleasent natural fish smell.<br>B. Slightly fishy or sulpher smell<br>C. Fishy/sulph-erous.<br>D. Spoiled. | COMMENT<br>(SEE PHOTOS) |
|---|---|---|---|---|---|---|
| YFN | A | A | A | B | A | |
| YFCO | C | B | B | A | A | |
| | | | | | | |
| 9-14 DAY 3: | | | | | | |
| YFN | B | NA | A | C | B | |
| YFCO | C* | NA | B | B | A (medicine, frying) | *SLIGHT FADING STILL UNNATURAL PINK/RED |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

# Appendix 14

# Residual Carbon Monoxide Level Test Results

# Japan Test Results
# Residual CO Measurements

**Results: Carbon Monoxide Mg/kg**

| Lot Number | CO Treated | Untreated | Tasteless Smoke |
|---|---|---|---|
| **25** | 1500 | **49** | **1000** |
| **88** | 240 | 40 | 400 |
| 215 | **470** | 30 | *550* |
| 224 | 1400 | **32** | 490 |
| *6* | 2100 | **43** | 1400 |
| **Averages** | **1142** | **38.8** | **768** |



\\\DC - 66887/1 - 0588038 01

## United States Test Results
## Carbon Monoxide by GC/FID with Catalyst

| Lot Number | CO Treated | Untreated | Tasteless Smoke |
|---|---|---|---|
| 27 | 682 | 56 | 416 |
| 60 | 76 | 8 | 101 |
| 223 | 390 | 18 | 174 |
| 4 | 335 | 35 | 280 |
| Averages | 370.75 | 29.25 | 242.75 |

SUBMISSION %

000106

[redacted]